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ALTERNATING-CURRENT GENERATORS AND CONVERTERS.

The three papers read at the recent meeting of the American Institute of Electrical Engineers and printed elsewhere in abstract, dealt with the construction and operation of alternating-current generators and converters. The mere production and operation of a non-synchronous generator cannot be considered novel, because induction motors have been used experimentally as generators for many years. Moreover, the characteristics of this machine have been studied by many investigators, and an outline of certain of its interesting and advantageous features was given in our issue for Jan. 17, 1903. According to the paper by Mr. W. L. Waters, and as restated by those who discussed his paper, the induction generator need not longer be treated as merely a laboratory curiosity, but deserves serious consideration as a reliable and satisfactory machine for certain duties. It seems to possess only one important disadvantage, its inability to produce its own exciting current or to deliver wattless current to the system. Where the equipment necessitates the continuous use of self-starting synchronous motors or converters having a rating largely in excess of the total wattless volt-amperes required by the load on the system and for exciting the generator, the induction generator can be used to advantage.

Mention has already been made in our columns of the vertical-shaft synchronous converter and of the split-pole variable-ratio converter. Although when first put forth some engineers may have considered these machines freaks in their line, yet apparently they have given satisfactory results in actual service. It is claimed for the split-pole converter that in spite of the fact that the counter e.m.f. of the converter may differ considerably in wave-shape from the e.m.f. of the supply system, there are no distortions in the current wave, and the power-factor remains at unity. If such results are actually obtained, then certain universally accepted theories need revision. It will be interesting to examine oscillograms of the current taken by the converter throughout its whole range of transformation when the impressed e.m.f. is sinusoidal. The paper by Mr. J. E. Woodbridge sets forth the advantages of a six-ring over a three-ring synchronous converter. Mr. Ralph D. Mershon, in an article printed in these columns about 12 years ago (June 15, 1895), established these advantages by mathematical demonstration, showing that the armature copper losses are more uniformly distributed in the former machine and that it can be operated at a greater output and higher efficiency than the latter machine. Mr. Woodbridge shows that the complication of three extra slip-rings and connecting circuits are of minor importance with converter rates at more than 500 kilowatts. An interesting feature of Mr. Woodbridge's paper is a discussion of the compounding of converters, which is the most complete treatment that has come to our notice. Although the suggestion to adjust the series reactances in the alternating-current circuits, the series field-turns in the direct-current circuit and the shunt

excitation, to produce unity power factor at one-half load, may not be the best for all conditions, yet the method explained in the paper is applicable to any problem, and it will prove useful to all persons concerned with the compounding of synchronous converters.

The Luminous Properties of Conducting Helium

The only primary standards of light we have to-day in physical laboratories are flame standards, in which a certain standard column of incandescent gas is produced by the regulated rate of combination of a definite chemical substance with atmospheric oxygen. It is found to be much easier to regulate the behavior of the chemical, such as oil, pentane, or amyl-acetate, than to regulate the behavior of the atmospheric oxygen, owing to the influence of contained steam or carbonic acid, the temperature and barometric pressure. Hence arise variations and uncertainty. This trouble with flame standards has led physicists to seek for a suitable luminous source of accurate reproducibility. If such a source could be found to be capable of reproduction by specification all over the world, to within, say, one-fifth of one per cent every time, the flame standards would probably die of envy and innocuous desuetude. An article by Mr. P. G. Nutting appears at page 390 this week, on a preliminary search for a helium primary light standard. The article shows that such a standard lamp, if it can be successfully realized, might consist of a glass tube of assigned dimensions and composition containing pure helium gas of definite pressure and carrying an assigned current strength. There are many difficulties in the way of securing such a standard of light. The kind and quality of glass for the tubes, the manipulation for determining the vapor-pressure of the helium, the care exercised in eliminating hydrogen, oxygen and other impurities—all conspire to make the path of the experimenter sufficiently thorny to satisfy the most ardent and pioneering spirit. Considering these difficulties, it is surprising that such good results are found as are reported in the article. There is some hope for the standardized Geissler tube after all. It is curious that although a relatively high efficiency may be looked for from lamps of conducting gas, owing to the selective frequencies of the gaseous atoms, yet in these particular cases the efficiency was rather below that of the standard carbon incandescent lamp. Whereas one watt of radiation in the visible spectrum might be expected to produce, say, a 10-cp point source, each watt in the reported observations produced only about one-quarter of a candle. Of course, if the lamp were otherwise satisfactory as a primary standard, its efficiency would be of no importance.

Lighting and Decoration.

Mr. Hunter's paper, read last week before the Illuminating Engineering Society and abstracted elsewhere, is a very striking illustration of the many-sided aspects of the art of illumination. It is also important as impressing the necessity for study of illuminating technique in attempting interior decoration under modern conditions. The expert on illumination must be a great deal more than a technologist; he must have a clear comprehension of essentials in physics, physiology and æsthetics. The definition of the illuminating engineer as "an electrical engineer with common sense" is both incorrect and slanderous. Most electrical engineers have common sense, but this does not prevent their making serious blunders when brought up against problems requiring special knowledge for their successful solution. Nor is it in the least necessary that the illuminating engineer start as an electrical or gas engineer, since his qualifications in these branches of engineering are of minor importance compared to the rest. Mr. Hunter's paper is particularly useful in pointing out the necessity of taking account of æsthetic and physiological facts in providing for illumination. A great deal has been written by artists on the æsthetics of color, but most of it is mere unconvincing guesswork, chiefly because the writers while familiar with effects have done little or nothing about the physical causes of them, and if possible less about the modifications produced by the use of artificial light.

We must confess to a deal of sympathy with Mr. Hunter's diatribe against color charts. They serve in some purposes a useful purpose, but from Lambert to his latest follower they are of small value save as regards the particular pigments or dyes concerned. The older charts being made from painters' pigments were reliable as regards these, but are useless for modern dyes. On the other hand, charts based on the fairly pure colors obtainable with dyes would be deceptive if applied to pigments of the ordinary sort. Both would disagree with the results from spectral colors. Even the often quoted table by Chevreul of the effects of colored lights on colors must be taken with reservations unless applied to pigment or old vegetable dyes, and somewhat cautionsly even then. So far as decoration is concerned, the range of colored lights has been extending of late. The Welsbach, the mercury arc and the yellow flaming arc give on colored surfaces effects that have never been classified and that can be properly reprobated only by trying them. For the decorator the effects of colors on each other have to be taken into account in considering illumination. Two papers may harmonize by gas light, but that is no sign that they will not swear at each other under the glare of an arc, or vice versa. The "electrical engineer with common sense" has no reason to know the laws of simultaneous contrast, but the decorator has, even though his knowledge is generally somewhat empirical, and the illuminating engineer cannot neglect them. This necessity of knowing something more than crude technology is well expressed in the many papers before the I. E. S. on topics touching physiology and the theory of optics as related to practical illumination.

We note that Mr. Hunter falls into the not unnatural error common among artists of thinking that the human eye is subject to great variations in color perception. So of course it is, if one considers the color-blind, who number perhaps five per cent of civilized mankind; but these have for the most part a single kind of error—red-blindness. Aside from the color-blind class, color vision varies comparatively little under normal conditions, and the peculiarities commonly ascribed to such variations are generally due to the effects of contrast and fatigue, which are striking enough, but temporary, and the same for nearly all individuals. To anyone interested in the practical applications of the theory of color we would recommend as a preliminary the perusal of a little book by Sir William Abney entitled "Color Measurement and Mixture." After assimilating this, one is qualified to begin the study of the general literature of the subject which, without such scientific introduction, will be found full of queer and contradictory statements. One useful point which Mr. Hunter brings out strongly is the difference

between general illumination and the special illumination needed for working purposes. For the former no "working plane" should be considered, since the whole interior is the thing which must be illuminated. Lighting well adapted to this purpose is generally inefficient for the latter purpose and vice versa. A room in a dwelling needs light for general purposes, a work-shop for special purposes. Neglect of this difference is likely to lead to very inartistic and unsatisfactory results. It is the business of the decorator to go after general effects and he requires especial aptitude and knowledge of color values for success. The lighting of a factory is child's play compared with this color-work. It is a most encouraging sign of the progress of the art of lighting when we find the architect and decorator joining hands with the engineer in an earnest effort to put the work on a thoroughly scientific basis.

LOAD FACTORS IN TOWNS WITH FEW STORES.

There are a number of cities in this country which, although of considerable size, have few stores owing to proximity to a large city where people go for shopping. It has sometimes been customary for central-station managers in such places to bewail their fate and say that the electric lighting business is poor because of the absence of stores, which are too commonly supposed to be the cream of the lighting business. A little investigation into the actual conditions in a city of this kind recently revealed the fact that the central-station company had a yearly load facor of 35 per cent, this being the ratio of the average to the peak load of the year. There are plenty of central-station companies operating in large cities which would be delighted to push their load factor up to 30 per cent. In the great majority of cases it is less than 25 per cent. Care should be be taken not to confuse this with the daily or monthly load factor, which may be considerably better than the yearly load factor. The case just mentioned with a 35 per cent load factor for the year indicates the beneficial effect on the ratio of earnings to investment of a central-station company to have a load which consists mainly of motors and residence lighting. Motor load in a manufacturing town runs from 8 to 24 hours, and the load factor of residence lighting by itself is likely to be much better than of commercial lighting by itself. Residence and power lighting loads overlap somewhat during November and December, but not to cause any such enormous peak as occurs when the commercial lighting of stores and offices is added.

NEW METHOD FOR OBTAINING THE POLAR INTENSITY CURVE OF A LAMP AND FOR RECORDING LUMINOUS INTENSITY.

Now that spherical intensity photometers have become established in use, so that it is possible to take an arc lamp, for example, and measure at one observation the total light flux it emits, or, immediately connected therewith, its mean spherical candle-power, the long and tedious process of measuring the candle-power of the arc zone by zone in elevation becomes unnecessary. The arc may wander along its meandering wayward path over the surfaces of the electrodes like an ant on a mole-hill, the feeding of the electrode may take place according to its own natural law of hunger, but the observation of the mean spherical intensity photometer or lumenmeter tells the whole story as to the total emission of light from moment to moment. In an article recently printed in the *Elektrotechnische Zeitschrift* and abstracted in the Digest, Dr. W. Voege points out that although the convenience of the lumenmeter for measuring total flux is great, a knowledge of the polar distribution of intensity can rarely be dispensed with when comparing different lamps, or when designing a lighting installation. Nevertheless, to have to go over the tedious zonal photometry once more, after the convenience of the lumenmeter, is to exchange ease and comfort for weariness and vexation of spirit. He suggests a plan that appears to have marked advantages for reducing the time and labor in making zonal luminous intensity measurements. Dr. Voege substitutes a little thermopile for the eye of the photometrist, obtains thereby a deflection on a thermo-galvanometer, which is recorded as the thermopile is carried in an altitude circle about the lamp under test, zone by zone.

At first sight, it might seem that a thermopile would not be applicable to replace the eye in a photometric apparatus. Nevertheless, it is easily understood that if a bright body is operating at all points at the same temperature, and rays from all its parts fall on the thermopile, the ratio of incident power in the visible spectrum to the total incident radiant power, will be constant. In other words, if a human eye at a certain angle of elevation from the source observes twice the illumination received at the horizontal plane, then there will be twice the radiant power in all regions of the spectrum, and a thermo-galvanometer should therefore also read double. Moreover, if a plain glass screen be interposed between the lamp and the thermopile, the great bulk of the invisible radiance will be cut off from the pile, and the remainder, reaching the pile, will be mainly luminous radiance. As the illumination changes, judged by an eye moving from zone to zone at constant radius, the thermopile should increase its e. m. f. in the same proportion, even although the red rays may stimulate the pile more than the yellow or blue rays. Of course, if the successive zonal aspects of the luminous source varied in temperature, the ratio of retina-stimulating radiance to total radiance would vary, and the readings of the thermopile would diverge from the corresponding readings taken by the eye in the ordinary photometer.

The article points out that in the case of the incandescent lamp, all parts of the filament are kept at substantially the same temperature, so that the proportionality of stimulus between retina and thermopile will hold. It is stated, moreover, that by experimental observation arc lamps maintain this proportionality sufficiently nearly for practical purposes, especially if they are provided with enclosing glass covers. A milky or semi-transparent cover, acting as a diffuser, naturally tends to maintain the said proportionality at all angles of emission, and thus gives the thermo-galvanometer a good chance to make its readings photometrically. All that is necessary is to move the pile-carrying arm, zone by zone, around the arc lamp in the vertical plane through the center of the same, and read off the galvanometer deflections as soon as they become steady. These deflections, plotted on a polar diagram, will then correspond to luminous intensities to some particular scale of reference. The scale may not be required, if the polar diagram is only to show the relative distribution of intensity. If, however, the scale is required, it is only necessary to observe some particular zonal intensity in the photometer in order to establish the relation. By recording photographically the thermo-galvanometer deflection with respect to time, the degree of constancy in the luminous intensity in any direction can be readily registered.

Electric Service Suspended in Atlanta.

The electric light, telephone, telegraph and street-railway service of Atlanta, Ga., was completely suspended for 36 hours by a heavy ice and sleet storm, beginning Sunday night, Feb. 9. The damage to the telegraph and telephone equipment was so heavy that the municipal authorities ordered the Georgia Railway & Electric Company to shut off all current. Underground lines in the fire district, however, were kept in operation, and by Monday night the arc-lamp service in the business center was resumed. Large forces of men were put at work by the Western Union and Postal Telegraph companies clearing up the wreckage. The stoppage of the Atlanta & Marietta single-phase railway also caused great inconvenience to business men.

N. E. L. A. Exhibitors' Committee Meeting.

A meeting of the National Electric Light Association exhibitors' committee was held in Chicago, Feb. 11, to formulate plans in connection with the exhibition to be held during the National Electric Light Convention at Chicago, May 19 to 22. Six members of the committee were in attendance. Plans were adopted to be submitted for approval to the executive committee of the National Electric Light Association, which is to meet in New York Feb. 20. Those present were Chairman F. H. Gale, General Electric Company; S. E. Doane, National Electric Lamp Association; W. S. Heger, Allis-Chalmers Company; H. M. Post, Western Electric Company; F. M. Holbrook, Crocker-Wheeler Company, and Walter Neumiller, of the New York Edison Company. Mr. Neumiller represented by proxy an absent member of the committee, and by virtue of his connection with the exhibition at last convention was able to give the committee valuable advice. The exhibits are to be in the former dining-room of the Auditorium Hotel.

Marconi Canadian Commercial Service.

The Montreal *Star* states that the service of the Marconi Wireless Telegraph Company has now been extended to include commercial, in addition to newspaper messages. It quotes Mr. J. G. Opp, manager of the Marconi Montreal office, to the effect that it is the intention of the company to extend the service to other commercial centers, and that offices will be opened in other cities of Canada within a short time. A flat rate of 15 cents per word is charged for commercial messages, this rate covering transmission over the land lines from Montreal to Glace Bay, and from Clifden, Ireland, to destination of message. The newspaper reports that a grain merchant sent a message by this medium to London and received a reply in two hours. It is not the present intention of the Canadian-English company to have American business transmitted through the Montreal office, owing, it is stated, to difficulties in land line facilities; but the erection of a station is contemplated in the United States, possibly in the vicinity of New York, for the benefit of the American public.

Electrical Mining Development in Mexico.

The greatest mining districts in Mexico to-day are those in which cheap electric power has been installed. Guanajuato, which is now producing its millions of dollars of ores per annum, was dormant for a century and more because the surface richness of the mines had been exhausted by the Spaniards and the cost of fuel was too great to continue operations. It was well known to the mining men of the early days that rich deposits of ores existed in the Guanajuato mines at greater depths, but it was impracticable to go deeper. In those days no power existed which could keep the lower workings clear of water or hoist the ore to the surface at low expense. The mines had to be abandoned with the wealth within easy reach.

Years and years rolled by and the Guanajuato mines lay idle. The first step in the direction of awakening the dormant industrial life of Guanajuato was taken by a syndicate of Americans. George W. Bryant, of Colorado Springs, Col., and associates organized the Guanajuato Light & Power Company and installed a great hydro-electric plant at El Durò, where a waterfall was utilized to furnish the initial power. Transmission lines were built to Guanajuato, a distance of 110 miles, Irapuato and other points in the states of Guanajuato and Michoacan. Sub-stations were built and the electrical energy was placed at the disposal of the owners of mines and other industrial concerns. It was soon demonstrated that this cheap power meant the reaping of fortunes out of abandoned mines and in opening new properties. American capital began pouring into the district, and it is estimated that more than $40,000,000 gold have been invested by Americans in what is known as the Guanajuato district during the last five years that the electric power and transmission plant has been in operation.

In addition to causing the rejuvenation of the ancient mines which had been idle for so many years, the introduction of electric power made it possible to operate low-grade mines which would not stand the expense of the ordinary fuel being used. It enabled the workings of the old mines to be deepened and as a direct result of this development ore bodies of vast richness have been uncovered in several properties and the output of the camp and district is attracting world-wide attention.

What has been accomplished at Guanajuato is being done also at El Oro and other mining camps of the republic. The Mexican Light & Power Company, which is composed of Canadian capitalists, extended its transmission line to El Oro from its hydro-electric plant, situated at Necaxa, near Mexico City. The mine operators of El Oro were quick to take advantage of the opportunity for cheap power, and many thousand horsepower were contracted for and are being installed at the different mines as rapidly as possible. One of the first of the larger companies operating in the El Oro camp to adopt electricity for its uses was the Compania Minera Las Dos Estrellas. It found that the new power gave the company an enorous saving during the past two years. The company has now taken steps to convert its mine railway from steam to electricity. To accomplish this it is having built a 450-hp motor generator set, comprising alternating-current motor, which will be located centrally with regard to the part of the road to be electrified, this set taking its power from the circuits of the Mexican Light & Power Company. The motor will drive a 300-kw direct-current generator for line supply on the trolley. This company already has in operation six electric locomotives in and about its mines. It is claimed that since the installation of this electric railway system the cost of hauling has been reduced one-half.

In the Cananea copper district, where the mines and smelters of the Greene Consolidated Copper Company are located, has been built one of the most extensive systems of surface electric mining roads in Mexico. The system covers all parts of the mining camp and extends into the mines. At Cananea, however, the cost of electric power is higher than in other parts of Mexico for the reason that steam instead of water power is used to generate the initial energy. The Necaxa plant of the Mexican Light & Power Company is situated at the Necaxa waterfalls.

Steps are now on foot to establish a great hydro-electric plant on the Santiago River, near the city of Guadalajara, for the purpose of affording power for mines and mills in remote districts of the state of Jalisco. The proposed transmission lines will be from 100 miles to 175 miles long.

A number of mines of the Sultepec district, state of Mexico, are now being supplied with power from the Sultepec Light & Power Company. This company recently installed a hydro-electric plant at Temascaltepec and built a 25,000-volt transmission line from there to Sultepec, where a sub-station was built for the purpose of supplying the mines with power. In

addition to the mines already being supplied, a number of other properties are being equipped with motors and other machinery preparatory to being operated by the new power.

There are individual electric plants at many of the mines in the principal camps of the states of Chihuahua, Sonora, Sinaloa, Coahuila, Zacatecas and San Luis Potosi, but in most instances these plants are operated by steam. Where steam is used the cost of the power is much greater than where the initial energy is generated by water. For this reason scores of water-power projects are on foot all over Mexico.

An American company will soon begin the installation of a hydro-electric plant on the Conchos River, in the state of Chihuahua, which will generate sufficient energy to supply the mining camps of Parral, Santa Eulalia and other remote places. It is planned by this company to build several hundred miles of transmission lines, the longest of which will be about 150 miles. A similar project of big magnitude is on foot in the states of Oaxaca and Coahuila. The establishment of a dozen of these plants of the size of that at El Duro and the one at Necaxa, if properly distributed throughout the country, will afford sufficient power to operate all of the mines and industries now in existence in Mexico.

Large Texas Hydro-Electric Plant.

A large hydro-electric plant is being installed on the Colorado River at Marble Falls, 40 miles northwest of Austin. There are natural falls in the river at that point and this natural dam of granite is to be raised to a height of 36 ft. by the construction of a cap of reinforced concrete. The material for the construction of this cap has arrived at Marble Falls and the structure will be built as rapidly as possible. The power of these falls will be used to generate electricity which will be transmitted to Austin, San Antonio and many smaller towns throughout the central and southwestern parts of Texas. Large granite quarries are being worked near Marble Falls and the power from the hydro-electric plant will also be used to operate the machinery of these quarries. The large lake, formed by the construction of the cap upon this natural dam, will be made a great pleasure resort.

The concern which is erecting this hydro-electric plant is called the Granite Manufacturing Company. G. W. Voires is manager. It is stated that the company has planned to establish a number of manufacturing plants in the vicinity of the power station. These include cotton, woolen, oil and flour mills. It is stated that the power can be commercially transmitted to San Antonio and Waco and other places, 100 to 125 miles distant, with ease, and that there will be abundant power left to supply the smaller towns and local industrial plants.

Scenic Niagara Falls.

Chairman Burton, of the House Committee on Rivers and Harbors, has been supplied with the following data of suggestions made by Frederick Law Olmsted for the improvement of the scenic conditions about the power plants and lower factory district at Niagara:

First. That the public ownership of the shores of Niagara River, already very large, should be extended to include everything between the head of the rapids and the end of the gorge, this control to extend everywhere far enough back from the brink to permit the maintenance of a permanent belt of forest trees sufficient to screen out from the scenery of the river all the factories, houses, hotels and other structures upon adjacent private lands.

Second. That any future structures needed in the development or utilization of power should be erected out of sight behind the enclosing belt of trees, that the penstocks of any new plant should be carried down through the rock as in the case of the Ontario Power Company, and that no new structures except inconspicuous intakes and outlets should be permitted within the limits of the reservation scenery.

Third. That provision should be made for the removal or the reconstruction in accordance with the requirements just above proposed of all the existing power plants that intrude upon the scenery of Niagara, at the expiration of a term of years sufficiently extended to give a fair opportunity for the plants to earn their cost, a sinking fund being established for cancelling the investment in the plants by means of an annual license fee for the use of the water, regulated according to the number of cubic feet per second allowed in each license.

It is further proposed in the general beautification of Niagara to remove the New York Central railroad tracks back from the edge of the high bank between the upper and lower steel arch bridges, planting a belt of forest trees to skirt the cliff.

The American Civic Association is advocating the extension of the provisions of the Burton bill for 10 years more, but Congressman Porter, of Niagara, will strongly oppose this. He considers that the Burton bill has already injured the interests of Niagara, and it is not proposed to permit it to kill it without a struggle for existence. There is a strong local sentiment that no measure ever struck such a blow at American industry, engineering and progress as the Burton bill.

The Consumption of Line Poles.

The U. S. Department of Agriculture has issued a bulletin giving the results of inquiries to determine the consumption of line poles during 1906. Inquiries were sent to over 6000 operating telephone and telegraph lines, electric light and power systems, trolley and street railway lines and steam railroad companies operating their own telegraph or telephone lines, and it is stated that replies were received from practically all addressed. The following table gives the number and average value per pole of round and sawed poles purchased in 1906:

	Number.	Value.
Cedar	2,174,279	$2.57
Chestnut	988,084	2.66
Pine	177,809	3.86
Cypress	111,657	2.30
Juniper	57,064	2.86
Redwood	24,760	3.56
Oak	9,924	1.41
Fir	9,601	2.25
All other	21,488	1.68
Total	3,574,666	$2.65

The total value of the poles was $9,471,171. As will be seen from the average value per pole at the point of purchase, pine stands highest and oak lowest. Round poles brought an average of $2.63 and sawed poles $4.22 each. Cedar and chestnut are the principal trees cut for round poles, and pine and redwood for sawed poles. Since the sap wood of pine decays rapidly, a sawed pine pole will last longer than a round one.

As to length of poles, the figures for cedar are: 1,305,148, 25 ft. long; 408,139, 30 ft. long; 262,739, 35 ft. long; 133,391, 40 ft. long; 70,452, 45 ft. long. The same order applies to other poles except cypress, in which case the largest number of poles were 30 ft. long. The total number of poles used by telephone and telegraph companies was 2,395,722, the average price per pole being $2.19; by steam railroad companies 254,268, the average price being $2.30; and by street railways, electric light and power companies 924,676 poles, the average price being $3.95. The report states that cedar poles are the most durable; chestnut and cypress come next, but the former is not so straight as cedar and is liable to be knotty. Pine is so much less durable than cedar that it cannot compete as pole wood without preservative treatment. Redwood possesses durability, lightness and softness, but its size necessitates sawing, which adds to the cost.

Poles which have not been treated by preservatives may be expected to give from 10 to 15 years of service, roughly speaking. Creosote is probably more extensively used than any other preservative, though ordinary paint is a common agent. For the butt, tar is often employed and charring by fire is found useful. By the comparatively new open-tank treatment, the preservative is forced into the wood of the butt by a much simpler and more inexpensive method than was formerly employed. The department has printed a circular (Forest Service Circular No. 104) on tank pole treatment.

Electricity in Peru.

Special Agent Charles M. Pepper has made to the Department of Commerce and Labor a report of the present state and future prospects of electrical development in Peru, as follows:

Electrical development in Peru is likely to call for increased purchases of material, notwithstanding the fairly large installations that have been made during the last two years. Hydraulic and electrical engineers the world over are familiar with the power that the Andes waters hold in reserve, but not all of them have kept pace with the recent application of this power and with the prospects for its further utilization. Some of the grander projects will have to wait a further period of industrial growth on the part of the west coast before they can become commercially feasible. Such is the proposed tapping of Lake Titicaca, by means of a tunnel through the crest of the Cordilleras, bringing 500,000 horse-power down to the Pacific. This vast volume of power cannot be utilized profitably for many years, though some day it will be done.

Other large projects, particularly in relation to railway traction, manufacturing and mining, are not so remote. The waters of the Peruvian Andes present ideal conditions for transformation into electrical energy in their freedom from ice, brushwood, leaves, etc., and these advantages are fully recognized in all the plants that are formulated. Peru now imports coal to the value of $1,000,000 annually, and it is estimated that 50 per cent of this amount could be saved in fuel by the use of water through electrical energy. When the Peruvian coal mines are opened up by getting railways to them there will still be economy in water-power.

The Central or Oroya Railway, running from Callao, and piercing the wall of the Andes in the Galera tunnel at an elevation of 15,665 ft., with 4 per cent grades and numerous zigzags and switch-backs, offers the best opportunity for the application of electrical power for traction on a large scale. This railway, the main sections of which were built by Henry Meiggs in the early seventies, is still both in its engineering features and in its scenic grandeur the most remarkable railroad in the world. Naturally its transformation into an electric line appeals to the ambition of electrical engineers, some of whom have made careful studies at their own expense and prepared elaborate plans. The ampleness of the water-power in the heights of the Andes is easily determined, but other questions requiring the judgment of experienced railway men, both in regard to engineering and to the relative economy of steam and electric power in handling traffic, have been carefully tested and with a favorable judgment. Some sections of the line present exceptionally favorable conditions for the economical operation of the road by electricity.

When the group of American capitalists who control the Cerro de Pasco mines offered to lease the Central Railway from the Peruvian Corporation, their plans contemplated the immediate electrification of the system and estimates had been made for that purpose. The offer was not accepted, and the line will continue to be operated by the Peruvian Corporation. I am informed that the project of changing the motive power to electricity has not been rejected nor yet has it been definitely determined. It is under consideration in the expert technical examination of the property that is now being carried on with a view to obtaining the funds for the physical rehabilitation of the system that is necessary in order to provide for the increased traffic. Financial reasons may prevent an early change to electricity, yet it is the opinion of those who have given careful attention to the subject that within a few years the change will be made, and that the economy of electrical power will be demonstrated.

Possibly before the Central Railway is operated by electrical traction the mining industry will undergo a radical modification. Electrical smelting is by many experts thought to be on the eve of introduction. The water-power is as abundant for it as for railway purposes. The Cerro de Pasco Company recently has completed extensive investigations of the power which may be obtained in the regions tributary to its properties, and the results are reported to be satisfactory. Within 36 miles of the smelter an available 15,000 horse-power has been located, while at a distance of 55 miles, and an elevation of 10,000 ft., there is 25,000 horse-power. The transmission is said to present no serious difficulties, and when detailed estimates of cost are completed, it is possible that definite steps will be taken for the installation of a great electrical power plant.

At Rio Blanco, 80 miles from Lima, on the Central Railway, the Boston capitalists who are erecting a big smelting plant, in order to take care of the ore in the neighboring districts, have about 3000 horse-power available, and are installing machinery for utilizing 400 horse-power when the smelter begins operations in April. The most successful mining installation up to the present time is reported to be that of the Inca Company, in the Santo Domingo gold fields of southern Peru. An electric plant of 400 horse-power, which was brought out and set up at some distance from the mine, where there was sufficient water-power, is said to be giving good results in working the ores on a larger and cheaper scale. In the Department of Ancachs, which is the chief mining province of the country, some installations of small electric power plants are in prospect and this is regarded as a promising field. The lack of railway and other means of transportation renders freights expensive, but this is no more burdensome for electrical machinery than for other kinds of mining machinery, and the saving to be effected in working the mines justifies the expense.

The future of the trolley tramways has definite bounds, since Peru has only a small number of cities where street-car systems are required, and most of these are already provided with trolleys or have contracted for them. Lima and Callao made the change from horse cars some years ago, and their local systems and the lines joining them are electric lines. One steam railway between Lima and Callao, which is controlled by the local trust or Associated Electrical Companies, will have its motive power changed from steam to electricity, and be used for freight. The largest extension is of the lines between Lima and the residence suburbs and bathing beaches on the seashore, the most important of which is Chorrillos. A parallel and competing line between Lima and Chorrillos, which depends on steam instead of on water-power for its motive force, was built and is operated with very unsatisfactory results to the stockholders, though recent extensions are said to improve the outlook for reducing the deficit. Ancon, a seaside resort, 30 miles from Lima, which has also the facilities of a commercial port, may have the steam railway replaced by the trolley. In the towns of Trujillo and Chiclayo, in northern Peru, existing electric systems are being extended, while the trolley may also be introduced in Paita and Piura, but for many other towns the single-mule tramway supplies all the necessary facilities for passenger traffic. At Arequipa, in southern Peru, an extension of the use of electric power is under way.

A few municipalities are not yet provided with electric lighting, but most of them have made provision for its introduction. Growth in the use of electric lights for private purposes in Lima and the other large towns is noted, and the companies engaged in supplying them find an increasingly profitable business.

Some of the larger sugar plantations have their own dynamos and small electric plants for lighting and other purposes, but these are not universal and the representatives of the various companies have still an open field. Efforts have been made to secure the introduction of electricity on the larger plantations to replace steam plowing, and convincing arguments have been made of the greater economy, but so far without much success. Even the most progressive of the planters are conservative on this point and stay by the English steam plow, which has been in use for a generation.

The minor applications of electricity, such as to domestic uses in cooking, etc., have been introduced in Lima with passably encouraging results. An electric cooking stove has had some sale at the hands of a persistent dealer. The high price of coal renders its use economical. Telegraphic and telephone apparatus have a good market, since these systems are regularly being extended. The government follows a definite plan

in extending the telegraph lines. The local Italian hospital obtains its electrical appliances in the United States.

The leading electrical enterprise in Peru at the present time is that known as the Trust, or the Associated Electrical Companies. This association supplies the power for all but one of the tramway systems of Lima and Callao, the electric lighting, and a variety of industrial purposes. The total available force is to be 17,000 horse-power, consisting of a central installation at Yanacoto of 8000 horse-power, of which 5000 horse-power is in two machines and 3000 horse-power in a third machine to be installed—5000 at Chosica, 800 at Santa Rosa, 400 at Piedra Liza—and 2500 steam power in reserve. The consumption in 1907 was 7400 horse-power for force and 3300 for lighting. The Rimac River and its affluents are the source of these combined installations. Two miles from Chosica, which is 30 miles from Lima, a cement dam, headgates and canal were built to divert the waters of a stream called the Santa Eulalia to the Rimac at a point about two-thirds of a mile higher. At this point a concrete dam and gates are located, which divert the waters of both rivers into a canal a mile and a quarter long. The canal has a grade of 1½ per cent. From the reservoir, two steel pipes of 1½ meters diameter each and 670 meters long, lead to the station. The effective head is 47 meters. Here five double-nozzle, double-wheel Peltons, direct-connected to General Electric revolving field three-phase generators produce 4000 horse-power. The velocity of the water as it strikes the wheel is 1800 meters per minute. From the switchboard the voltage is raised to 35,000 volts, and transmitted to Lima over a double set of transmission lines. At the chief station in Lima this high voltage is reduced to 2300 for distribution.

Just below the bridge at Chosica a third dam has been built, and the river is again taken for the third station at Chacra Sana, farther down the river. At the side of the dam three gates, having their tops level with the crest of the dam, lead the water to the canal. In the dam, just below the entrance gates to the canal, is located an all-steel gate, having its bottom 2 ft. below the canal gate. This is to remove the immense quantities of sand and rocks that the river carries during high water. In three other places along the canal are located settling chambers and waste gates, to remove automatically the sand and gravel. This canal is 3 miles long, 1¼ miles being in earth and the remainder having cement walls and floors. The gradient is 3 ft. per thousand.

From the reservoir a steel pipe line 6 ft. in diameter and 400 meters long carries the water to the station. The effective fall is 79 meters. At this station larger units are located, each of 2500 horse-power, two of which are in operation, the third, of 3000 horse-power, which will be installed, giving a total capacity for the station of 8000 horse-power and 12,000 horse-power for the two hydro-electric stations. These two stations operate in parallel, or in synchronism with the Lima generating stations. The Chacra Sana station is constructed of solid concrete with concrete block trimmings for the doors and windows, and steel roof, entirely fireproof. It is 10 by 48 meters. From the transformer room 50-ft. steel towers carry the transmission lines.

The Lima receiving and generating station has two 750-hp water-wheels that operate under a head of 24 meters. A reservoir and steel pipe line, the same size as the Chosica No. 1 station, has an automatic relief pipe, 70 ft. high and 5 ft. diameter, that takes care of any sudden closing of the turbines, thus relieving the pipe line and wheels of dangerous strains. The steam section consists of seven engines and boilers, with an aggregate capacity of 3000 horse-power.

From the general station at Lima all public and private circuits, power circuits and railroad circuits are controlled by a switchboard with automatic switches. For the public street lighting, 10 circuits supply current to 400 of the latest type inclosed arcs and 1200 series incandescent lamps for the streets of Lima. The private lighting service for Lima, Callao and other towns is all supplied from the principal distributing station at Santa Rosa, Lima. Over 60,000 incandescent lamps are connected.

The Trust or Associated Companies is controlled by Lima capital, but the machinery is from the United States and the installation was made under the direction of American engineers. All the leading electrical companies of the United States have supplied machinery for the various installations in Peru, and their representatives have supervised most of the work. The chief German company, whose head offices are in Berlin, is an active competitor through its local representatives, and it has furnished the installation for the tramway system that does not have water-power, for some municipal lighting and traction plants, and industrial plants including mines, a cartridge factory and elevators. A Belgian company, with headquarters at Liege, maintains a local agency.

The prospective application of electricity on a large scale, such as for the Central Railway and for the Cerro de Pasco mines and smelters, I have described, but there seems to be a more immediate application for light manufacturing. About 2000 horse-power on five power circuits is now furnished by the Trust to the cotton mills, flour mills, biscuit, chocolate and cigar factories of Lima and vicinity. Coal is expensive fuel for the local industries, and it has been demonstrated that with the water-power which is available electric force can be furnished cheaper.

Most of the electric companies have their own agents and representatives in Peru, and no suggestions, therefore, are necessary as to the means for reaching this market. The point on which I would lay stress is that electricity in all its forms will play a continually growing part in the industrial development on which Peru has entered, and the local conditions are such as to assure that the present world-wide monetary stringency will not seriously interrupt this development. Many enterprises are at the stage where they can be carried forward profitably by the utilization of electricity, while to stop means loss. The industrial impulse in Peru is in reality too strong to be checked.

February Meeting of the A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, on Feb. 14, papers discussing alternating-current non-synchronous generators and synchronous converters were presented by Mr. W. L. Waters, Mr. Charles W. Stone and Mr. J. E. Woodbridge. Abstracts of these three papers are given on page 384 of this issue.

In a written communication Mr. C. F. Scott stated that the non-synchronous induction generator discussed by Mr. Waters possesses certain marked advantages in eliminating hunting and minimizing the short-circuit current. He said that both the split-pole method of voltage regulation of synchronous converters, as described by Mr. Stone, and the series-reactance method treated by Mr. Woodbridge involve a variation in the power factors, while when transformer loops, induction-regulators or boosters are used the power-factor may be held at unity.

Mr. P. M. Lincoln showed by means of flux-distribution and counter-voltage curves that a converter constructed with three-part poles requires so much more material than an ordinary converter as to make it an uncommercial machine. However, a converter with two-part poles requires less material than a three-part-pole machine but more than an ordinary converter. Moreover, the efficiency of a split-pole converter is as low and sometimes lower than that of a combined standard converter and separate booster, and it introduces considerable wattless current of high frequency into the system.

Mr. F. J. Clark discussed in detail each advantageous feature claimed by Mr. Waters for the induction generator and pointed out certain disadvantages which preclude its use in large stations where synchronous alternators are now installed. He expressed the opinion that induction generators when used with synchronous converters will prove superior to turbine-driven direct-current generators which have not been very satisfactory. In speaking of the various methods of starting converters, he said that on the Long Island Railway System absolutely no trouble has been experienced with the small induction motors used for bringing the armatures up to speed.

Dr. C. P. Steinmetz remarked that the proper work for the induction generator is in supplying power to synchronous apparatus—motors as well as converters. The one field to which the induction generator is preëminently suited is in the parallel operation of small hydro-electric plants with engine-driven equipments. There should be used a synchronous machine controlled at constant speed by means of a steam engine and an induction generator directly connected to a water-wheel operating without a governor. The latter generator supplies to the system all of the available power from the water, while the other generator supplies the rest. Where numerous small waterfalls are scattered over a large area, many small, direct-connected induction generators could supply power to a common transmission system delivering to synchronous apparatus.

Prof. C. A. Adams showed that the excess in the synchronous motor equipment required when some of the receivers demand lagging wattless current which the induction generators cannot supply, should not be urged against an induction generator when compared with a synchronous generator, because the latter machine must be constructed with increased amount of material when it delivers wattless current.

Mr. J. R. Bibbins called attention to the fact that the modern gas engine gives as good service as the modern reciprocating engine. Even when used with 60-cycle generators spring couplings are not necessary. Thus the demand for special generators for use with gas engines is not so urgent as formerly.

Mr. Philip Torchio said that the New York Edison Company about three years ago placed a contract for an induction generator to be used with a synchronous motor, as an emergency equipment, but the manufacturer failed to deliver the machine on time and standard machines were chosen.

Mr. J. B. Taylor expressed the opinion that there has been no case where the e. m. f. wave-form was responsible for any definite trouble and where it was necessary to take steps to change the wave-shape or to modify the constants of the circuits in any way in order to permit the system to operate.

The Effect of Light on the Eye Discussed at Chicago.

The Chicago Section of the Illuminating Engineering Society met in the breakfast room of the Grand Pacific Hotel Feb. 13 to discuss the effect of artificial light on the eye. The paper by Dr. H. H. Seabrook, read before the New York Section Jan. 9, was first read, after which several prominent Chicago oculists took part in the discussion.

Dr. Edwin J. Gardiner put the kerosene lamp at the head of the list of illuminants used near the work, because of the low candle-power per unit area of flame and the dense opal shades commonly used. The general principles he laid down were that in artificial lighting the light should come from as large surfaces as possible to imitate daylight. He thought some of the indirect lighting of large interiors where the lamps were concealed in coves was excellent. In his opinion the quantity and intensity of the sources of artificial light in a room would have more to do with injuring a very sensitive or slightly inflamed retina than the color of the light. He was asked by Chairman Cravath whether the incandescent lamp provided with a frosted bulb and covered with a dense opal dome shade like the ordinary kerosene reading lamp would not give practically the same results and be just as good for the eyes as a kerosene lamp used under the same conditions. Dr. Gardiner said that it would. He admitted that the bad effect of the incandescent lamp was due to the way it is frequently misused.

Dr. George F. Suker agreed with Dr. Gardiner on all of the points just mentioned. He called special attention to the necessity of looking well to the illumination provided for children both in the schoolroom and the home. In connection with lighting in the home living room, he called attention to the fact that frequently if a table lamp only were provided, the grown people would occupy the best positions, and the children would be allowed to sit around in whatever room was left with an inferior illumination. For this reason he favored providing means whereby a considerable area in the room would be lighted to a high enough intensity for reading in order that the whole family might have ample light. He emphasized the bad effects due to streaks caused by light from incandescent lamps not properly equipped, and also said that it was bad to have dark corners in a room because of the violent change which the eye must make in looking from a lighted area into a dark corner. He spoke of the prevalence of the disease of cataract of the eye in India due to the religious custom of looking at the sun. There is also a disease termed electric cataract resulting from too strong electric light shining in the eyes. Like Dr. Gardiner, he agreed that probably the question of color was not as important in connection with damage done to the eye by artificial light as was the question of the intensity per unit area of the source of light, but unlike Dr. Gardiner he preferred to protect a sensitive, diseased eye by amber glass. Dr. Gardiner for similar purposes uses blue glasses, believing that the important thing is to relieve the eye of the stimulation of the great quantity of yellow rays which are present in most artificial lights rather than to look after the few chemical rays.

Dr. Gardiner gave one very notable instance in his experience which demonstrated the practical effect on the eye of good and effective lighting schemes. The study room in a boys' school at Lima, Ind., several years ago was lighted with unshaded incandescent lamps hung on drop cords. The school was a regular gold mine for the oculist. There was hardly a boy in the school that was not complaining of his eyes. A scheme of indirect illumination was worked out whereby the lamps were concealed and the illumination was received by reflection from the ceiling. The eye trouble completely disappeared, and the school ceased to be a source of profit for the oculist.

Dr. Henry Gradle spoke of experiments carried on in Germany in connection with lighting of school rooms, as a result of which it was concluded that an illumination of 50 meter-candles (about 5 foot-candles) was desirable on the desks. He enunciated very clearly the principles which, as an oculist, he would advise be carried out in artificial illumination. These principles are the same as are generally recognized by the most advanced illuminating engineering practice of to-day. He favored placing light sources high out of the line of ordinary vision, and using diffusing glass between the lamp and the eye. Indirect lighting, or lighting by reflection from the ceiling was also favored.

Dr. Suker told of one notable specific case in his practice where a stenographer, who had been working by a desk lamp placed in front of her, had eye trouble which for a time baffled him. He had asked the usual question as to the kind and position of lamp used, and was told that it was satisfactory. After several months he instructed the patient to have the lamp placed so that the light would come from behind. She was thereafter able to do without glasses, and has had no further trouble, although he had monthly reports made to him as a matter of scientific interest, to determine whether the trouble returned.

Mr. A. D. Curtis asked the oculists present for an opinion as to whether indirect lighting in which lamps are concealed and the illumination received by reflection from large surfaces would be considered by them unquestionably the best method of artificial lighting, provided it were commercially feasible. Drs. Gardiner, Suker and Gradle all agreed unhesitatingly that the indirect lighting system would be the best. Mr. George C. Keech said that indirect lighting had been discussed many times in this society, but that the thing which had always stood in its way was its prohibitive expense because of its inefficiency. Chairman Cravath called attention to the fact that some of the rooms lighted indirectly which had received the most criticism, both on the grounds of inefficiency and uncomfortable effect on the eye, were rooms in which the indirect lighting was not skilfully designed. Those attending the convention of the society at Boston last summer had the pleasure of meeting

in a room lighted by a reasonably efficient indirect-lighting system, and one which was practically free from the objectionable effects on the eye which had been urged against the indirect lighting in certain rooms in which tests reported to the society had been made.

Varnished Cloth Insulation.

On Feb. 5, the Pittsburg Section of the American Institute of Electrical Engineers held a meeting in the Carnegie Institute Lecture Hall after an informal dinner at the University Club. Several papers dealing with varnished cloth insulation were read and discussed.

Mr. Henry W. Fisher read a paper on varnished cloth insulated cables which was very interesting and instructive, and while most of the processes of manufacture are still secret, Mr. Fisher gave some good data. The samples of cloth are made in thicknesses varying from 5 to 16 mils. The specific gravity of varnished cloth is very close to 1, and while the electrical properties of different makes vary widely, some average tests made on samples of a circular foot in area showed as follows: Insulation resistance, from a few megohms to 955 megohms per mil.; alternating electrostatic capacity, from .11 to .26 microfarad; breakdown e. m. f., from 120 volts to 860 volts. The power factor of varnished cloth is an important consideration. One sample when tested with 20,000 volts for two hours became very hot, while a similar sample of another kind was perfectly cool after a similar test. Mr. Fisher exhibited a number of samples of varnished cloth cables, some lead-covered and others covered with an asbestos braid for switchboard work.

Mr. A. B. Reynders explained the great variety of uses to which varnished cloth is put in modern electrical machinery. As insulation for curved surfaces it stands alone. He also explained the different processes of its manufacture, and said that when finished it would withstand an e. m. f. of from 800 to 1200 volts per mil of thickness. The methods of inspection and testing are arranged to insure that the cloth will withstand bending and creasing without breaking down. The testing surfaces should be flat discs. The cloth should withstand baking at high temperature for a number of hours without being injured. A temperature of 300 deg. Fahr. or over will injure the mechanical strength of the cloth.

Mr. G. A. Jacobs expounded the technical requirements of varnish in varnished cloth. He called attention to the fact that it is impossible to obtain a quick-drying varnish that will remain permanently elastic. A varnish should never lose its life and elasticity when used at temperatures below 180 deg. Fahr. He said that most oxidizing or drying agents continue to dry out the cable after the main process has been completed, and for that reason alone the varnish loses its elasticity with age. Hot air is one of the most reliable oxidizing agents. Varnished cloth should also possess the property of adhering to itself.

Dr. Riddle read a paper for Mr. James Todd, of the Sterling Varnish Company. Mr. Todd believes that the mechanical properties of varnish-insulated cloth are just as important as the electrical properties. A cloth should be given an endurance test as well as a quick-puncture test. Varnished cloth is best when made up of a succession of layers dried one on top of the other. Some kinds of oil tend to rot the cloth. Linseed oil should be purified before being used.

In a general discussion of the subject, Mr. S. P. Grace called attention to a varnished cloth-insulated cable several miles long, used by the Pittsburg Railways Company, for carrying a three-phase energy at 13,000 volts from Brunots Island to Bellevue. This cable is hung aerially, without lead sheathing, and has been working for several years without giving any trouble with the exception of one splice that was improperly made. He considered this an important stride onward in the art of high-tension energy transmission. He also spoke of trying varnished-cloth distributing wires for telephone service.

Mr. Paul Lincoln mentioned the use of varnished cloth-insulated cables as a protection against break-downs caused by electrolysis.

Mr. B. P. Rowe called attention to the advantages of using varnished cloth-insulated cables with asbestos covering for power switchboard work and short duct runs. He called attention to the great permanency of everything about a switchboard except the insulation on cables. He thought this should be made as permanent as the barriers built for protection. He spoke of the advantage of doing away with bells on cables without lead-covering.

Mr. C. E. Skinner thought that an asbestos covering for varnished cloth-insulated cable is advantageous for fireproofing the wires. He also spoke on the subject of the manufacture of varnish, calling attention to the three principal agents for oxidizing linseed oil. These agents consist of heated air, borate of manganese and oxide of lead.

Messrs. R. D. DeWolfe and O. A. Sandborgh gave some data regarding power-factors and the weakness of varnished cloth under high temperature. Some linseed oils under test show a power-factor of 50 per cent, and other oils show as low as 10 per cent.

Mr. R. Wilson spoke highly of varnished cloth-insulated signal cables, which have been in use for a long time, and have proved absolutely unaffected by oil.

The Single-Phase Railway System.

In a paper read before the Philadelphia branch of the American Institute of Electrical Engineers, on Feb. 10, Mr. William McClellan said that among the improvements that will probably be introduced in the present high-voltage trolley circuits are a reduction in the number of insulators at which break-down can occur, and a greater amount of sectionalizing on single-track and double-track roads than has heretofore been considered necessary. For example, there could be used at curves a pull-off combining in one insulator the two that are now employed for pull-off and suspension. The pantagraph trolley mechanism as at present designed is not wholly successful, and important modifications will have to be made. The effective weight of the moving piece in contact with the wire must in some way be lessened. This cannot be done by lessening the actual pressure of the shoe on the trolley wire, but must be accomplished in the design of the shoe, so that its equivalent inertia is greatly reduced.

Little practical difficulty is caused by smoke, provided the insulation of the overhead system is properly designed. Although much study was required before a solution was found for the problem of overcoming the interference of single-phase railway systems with adjacent telegraph, telephone and signal systems, no difficulty is now experienced in avoiding the disturbances.

Viewing the single-phase system from the standpoint of several months of experience, one must conclude that it is destined to be the means by which at least a portion of the transportation work of this country will be accomplished. No man ought to be so foolish as to prophesy that the present overhead structure, or the present type of motor, will be the final type. In fact, it is not known whether an e. m. f. higher or lower than 11,000 volts will be found most acceptable in the future. It is true that if an e. m. f. higher than 2000 volts is to be used, reasons of safety need not deter one from selecting an e. m. f. as high as one pleases. Considering the fact that insulation on a railroad should be almost absolute, it is as easy to insulate for 11,000 volts as it is for 2000. The only feature which will need considerable attention if single-phase lines are extended widely across open country is lightning protection. This has proved the only hard problem in all transmission work heretofore. In connection with transmission lines, it is easy to provide lightning protection for e. m. fs. not over 11,000 volts. The conditions on trolley lines, however, are somewhat different, inasmuch as distances must frequently be cut down to a minimum, and new problems will have to be solved.

The important point for all interested to observe is that single-phase has, and probably always will have, limitations. Each problem must be viewed from the standpoint of its own local position. It is not too much to say, however, that some general conclusions may eventually have to be reached. In view of the fact that in order to obtain the greatest usefulness from all railroads, it is likely that they will have to be laid out for a uniform system. While a high-voltage single-phase or 1200-volt direct-current overhead, or 650-volt third-rail system, may be distinctly unfavorable for certain cases, one of them will have to be chosen to make for standardization.

CURRENT NEWS AND NOTES.

GOVERNMENT COAL SPECIFICATIONS.—The U. S. Geological Survey has issued a bulletin (No. 339) with Mr. J. T. Randall as author relating to the purchase of coal under government and commercial specifications on the basis of its heating value. Methods of sampling and testing are given, together with tables of analyses of coal delivered to the government.

SOUTHERN APPALACHIAN WATER POWERS.—The U. S. Department of Agriculture has issued, in accordance with an act of Congress, a report on the watersheds of the Southern Appalachian Mountains, which includes a section on the water powers of the regions considered. The minimum horse-power is reported at 2,740,700, and the maximum for six months of the year at 4,929,573.

WESTINGHOUSE FOREMEN'S BANQUET OFF.—The Foremen's Association of the Westinghouse Electric & Manufacturing Company, at Pittsburg, will not hold its usual annual banquet on Feb. 27. All arragements had been made, but because of the many men out of work the foremen decided to declare the banquet off and to devote to charity the thousand dollars to have been spent on the dinner.

HIGH-EFFICIENCY LAMPS IN BERLIN.—According to a recent visitor to Berlin, Germany, only flaming arc and high-efficiency incandescent lamps can be there seen in the business portions of the city, and that 90 per cent of the outdoor lighting is now done with flaming-arc lamps. Both tantalum and tungsten lamps are used, but the former are seen usually in old fixtures where the lamp cannot be placed vertically.

TWENTY-FIVE THOUSAND ELECTRIC IRONS FOR CHICAGO.—The *Chicago Examiner*, a paper owned by W. R. Hearst, has made a contract for 25,000 six-lb. General Electric flatirons to be used as premiums with subscriptions to that paper. The contract provides for the immediate delivery of 5000 irons. If these irons are all disposed of among central-station customers in Chicago, they ought to make quite an addition to residence revenue.

N. E. L. A. CONVENTION DISCUSSIONS.—President Dudley Farrand, in the current issue of the *N. E. L. A. Bulletin*, states that numerous requests have been received to hold at conventions simultaneous meetings for the consideration of widely different subjects, and at the coming Chicago convention the experiment will be tried, a second meeting room having been provided. This arrangement will permit of specializing by committees to any degree desired, thus obviating separate organizations in the association, to which principle the present administration is opposed.

SCHENECTADY A. I. E. E. SECTION.—At a meeting of the Schenectady Section of the A. I. E. E., held on Feb. 13, with Mr. S. T. Dodd in the chair, Mr. C. J. Mellin, consulting engineer of the American Locomotive Company, gave a talk on the "Design of Steam Locomotives." There were about 300 present, Mr. S. T. Dodd, acting chairman, opening the meeting with a few general remarks on the subject. Diagrams of construction, curves and photographs of locomotives were shown by means of lantern slides. Mr. Mellin also gave a detailed description of the Walschert valve, illustrated by diagrams. On Feb. 20, Mr. E. J. Berg, of the General Electric Company, will deliver a lecture before the Schenectady Section on "Rotary Converters."

NEW YORK "HOME" SHOW.—The "Home Show" will open at the Grand Central Palace on May 2 and run for a week. As the name indicates, the show will be devoted to the home, and to all things in the constructive, decorative and furnishing lines that pertain to the home. A special effort is being made to obtain the best and latest electrical devices and convenience for exhibition, and the application of electricity as used in a hundred ways in the up-to-date house will be fully demonstrated. An invitation to architects, builders and contractors to attend the show as guests of the management will be extended and special efforts will be made to obtain their co-operation. William Horwood is president of the Home Exhibits Company, which has the exhibition in charge; I. L. Wilfong is vice-president; and G. C. Horwood, secretary.

EFFECT OF FREQUENCY ON FLICKER.—Bulletin 157 of the University of Wisconsin has for its subject a comparison of the effects of frequency on the light of incandescent and of Nernst lamps. The author is Mr. Frederick W. Huels and the paper is preceded with an introduction by Mr. Marshall W. Hanks. The experiments were made with frequencies from 6 to 20 cycles per second, and showed that the incandescent lamp is not suitable for use at such low frequencies. The Nernst lamp, however, was found to be "quite satisfactory at frequencies as low as 15 and 17½, for outdoor illumination at least." Mr. Hanks refers to a previous investigation by Mr. H. Seaman from which it was found that apparent fluttering to the eye of light from the incandescent lamps starts at about 28 cycles, and at 25 cycles is quite apparent. He ascribed the greater steadiness of the light from the Nernst lamp to three causes, namely, the comparatively thick filament; the sensitive balance resistance, and the fact that the greater part of the current flows through the hot center of the glower owing to the negative temperature coefficient of the latter.

RAILWAY ELECTRIFICATION.—In a paper read Feb. 6 before the Royal Automobile Club of England, Mr. Philip Dawson presented the following conclusions to a discussion of the subject of railway electrification: (1) Electrification of the suburban portions of railways dealing with heavy local traffic appears to be essential, both in order to meet the very serious tramway competition, as well as in order to better utilize existing track and terminal facilities, and in order to save the enormous capital expenditure which an enlargement of the number of tracks and terminal facilities (even if, and when possible), would involve. (2) As regards the system to be adopted, it should be such as to easily lend itself to extensions, even to considerable distances, and so as to interfere as little as possible with existing structures and permanent way, and to cause no fresh source of danger and annoyance to railway employees. (3) It is useless to expect satisfactory financial results except when electrification is adopted on such a scale as to make it possible to fully reap its benefits and unless it is so installed and operated as not to be constantly interfered with by existing local steam trains sandwiched in between the electrical ones. (4) It is no use adopting electric traction if rolling stock of such a nature and design is adopted as will neutralize the benefits resulting from electric traction at termini. (5) Economies in working may, and will, no doubt, result if and when the system has been sufficiently developed, but if electrification is only resorted to in order to decrease working expenses, and not in order to increase the earning capacity, then nothing but disappointment must be expected. (6) It is no use electrifying unless frequent as well as rapid service is given.

TELEGRAPH REGULATION.—A bill has been introduced in the New York Legislature compelling telegraph companies to stamp conspicuously on every telegram the hour of filing, as well as the time received.

INTERNATIONAL GAS-POWER REVIEW.—The first number of a monthly journal of this title bears the date of January, the publication office being at Watertown, N. Y. The plan of the publication is that of a monthly index of literature relating to gas power. The United States patents granted monthly in this branch of invention are also recorded.

NEW YORK FIRE ALARM SYSTEM.—The New York Board of Fire Underwriters have begun an investigation of the New York City fire alarm system. About two years ago Mr. Kempster P. Miller conducted an investigation of the system for the Fire Underwriters, the result of which were recommendations that the present system be replaced by a new and more modern one.

SCHENECTADY A. I. E. E. SECTION.—A lecture on the subject of "Gas Power" was delivered before the Schenectady Section of the A. I. E. E. on Feb. 6 by Mr. H. H. Supplee. Mr. J. M. Knox, of the General Electric Company, and recording secretary of the local section, acted as presiding chairman. The lecture was illustrated by an interesting series of lantern slides showing gas-engine installations, both in America and abroad.

MUSICAL COOKERY.—A correspondent of the Chicago *Daily News* who had his interest in electric cooking excited by the exhibit of apparatus at the recent Electrical Show, suggests that an electric piano be attached to the electric stove in order that when certain dishes are in preparation the piano will cheer the cook by playing an appropriate tune. A long list of tunes is given; to accompany the cooking of potatoes, "Melodies of Ireland" is suggested, and for frying sausages, "Broken Links" is offered as appropriate.

CHICAGO ELECTRIC SHOW.—In the notice in our issue of Jan. 25 of the Chicago Electrical Show, it was stated that the attendance was somewhat less than in previous years. We are informed by Mr. Homer E. Niecz, manager of the show, that this statement is incorrect, as not only was the attendance greater than at the previous shows, but the interest shown in the exhibits was even greater than previously, indicating that the show had increased in favor with both the trade and the public rather than the reverse.

IOWA WATER POWERS.—State Railroad Commissioner N. S. Ketchum, of Iowa, advocates the organization of a syndicate with large capital to develop the numerous water powers in the State for the generation of electricity for electric light, railway and power purposes. He states that millions of dollars of water power is now annually wasted which through such a syndicate could be utilized. Among towns, he says, that would thus be benefited by the development of water powers are Keokuk, Fort Dodge, Frazier, Des Moines, Peterson, Ackley, Marshalltown, Waterloo, Boone, Eldora, Steamboat Rock, Webster City, Ottumwa, Oskaloosa, Sigourney and Knoxville.

ST. LOUIS ELECTRICAL SHOW.—The Missouri Independent Telephone Association and Missouri Electric Light & Street Railway Association will meet at St. Louis between April 18 and 25, the dates having been fixed to coincide with those of the St. Louis Electrical Show. The novelties of the recent Chicago Show will be on exhibition, and the Union Electric Light & Power Company proposes to make the finest "Home electrical" exhibit yet attempted. At a meeting held last week at Planters' Hotel, all of the electrical interests of St. Louis were represented and pledged their earnest support to the enterprise.

EDISON MOVING-PICTURE LITIGATION.—It is announced that an arrangement has been made with moving picture manufacturing interests and concerns which rent machines whereby all litigation relating to Edison patents will be withdrawn. The arrangement is in the interest of the Edison Moving Picture Company, and it is stated by the president of one of the large companies entering the combination that $1,000,000 would be a conservative estimate of the annual returns to Mr. Edison on the moving-picture patents now that his rights are conceded. We understand that Mr. Edison's personal benefit from the arrangement will approach $150,000 per annum.

WESTERN SOCIETY OF ENGINEERS.—A meeting of the Electrical Section of the Western Society of Engineers was held at Chicago, Feb. 14, at which Mr. James N. Hatch presented a paper on "The Evolution of the Electric Railway," profusely illustrated with lantern slides. The paper was mainly historical. At the close of the paper Mr. D. W. Roper, chairman, called attention to the interesting fact that the output of power houses supplying electric railways of various kinds is about three times that of power houses supplying central-station electric light and power. The Commonwealth Edison Company in Chicago has been supplying power to take care of the growth of several of the principal surface and elevated railway lines for several years past. Its output for electric railway purposes is now about one-half of its total output.

ANOTHER MEXICAN HYDRO-ELECTRIC DEVELOPMENT.—The Kansas City, Mexico & Orient Railroad Company will soon commence work on a large hydro-electric plant on El Fuerte River in the state of Sinaloa, Mexico. A survey for the proposed plant is now being made by Mr. A. M. Nelson, the engineer and superintendent of the railroad in Mexico. It is stated that the initial installation will be for 10,000 horsepower, and it is planned to use the electric power for operating the railroad at one or more places in its course through the Sierra Madres. Power also will be used in the construction of tunnels and other difficult work in building the road through that section. There are several large mining camps within convenient distance to the site, and transmission lines will be built to these and power furnished for running mining machinery.

GRAND HAVEN, MICH., MUNICIPAL PLANT.—The *Tribune*, of Grand Haven, Mich., in a recent issue criticises severely the municipal electric lighting plant of that town, which it states has been misconducted, misdirected and "politicked" to death. For the past two years, it says, the street lights have been comparable to "red-hot irons stuck up in the air," and that in some parts of the town matters have come to such a pass that people have gambled on whether or not they would have lights at a certain hour on a certain night. "At the plant things have been going to smash right along. First one machine would burn out or be wrecked, then another. The tax-paying public has been contributing regularly to repairs and rebills, and it has been like dumping refuse into a quicksand pit."

CENTRAL-STATION AGREEMENT WITH WORKMEN.—The Scranton Electric Company has entered into an agreement with its firemen and engineers covering a period of 10 years in the case of firemen and three years in the case of engineers; the agreement with the firemen, however, provides that every three years there may be a discussion looking to an adjustment of the wage scale. The agreement includes a stipulation that there shall be no discrimination between union and non-union men. Bonuses for increased efficiency will be paid on a basis that has been mutually agreed upon. It is also provided that firemen who have been in the employ of the company for a year, and who pass an examination equivalent to that of the Scranton Correspondence Schools, will receive an increase of $5 per month.

TOULOUSE INTERNATIONAL EXPOSITION.—The city of Toulouse, France, has organized an International Industrial Exposition, to open in May of the present year and extend to September. It will then be in direct competition with the International Exposition to be held at Marseilles during the present year.

TOLEDO A. I. E. E. SECTION.—At the February monthly meeting of the Toledo section of the American Institute of Electrical Engineers, Mr. H. W. Fisher, chief engineer of the Standard Underground Cable Company, of Pittsburg, spoke on "Electrical Cables." Mr. C. R. McKay, chairman of the Toledo section, opened an interesting discussion that followed the reading of the paper.

INDUSTRIAL EDUCATION.—The Winona Technical Institute, of Indianapolis, Ind., has strengthened its course for electricians, which has become very popular. The enrollment of the institute has increased rapidly, and numerous gifts in the way of equipment have been made to its several departments. Instruction is now given for electricians, carpenters, painters and house decorators.

MEETINGS OF THE I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society, held on Feb. 13, the secretary announced that at the forthcoming March meeting of the section a paper will be presented by Mr. E. L. Elliott dealing with architectural principles and illuminating practice from the viewpoint of the illuminating engineer. At the April meeting Dr. E. L. Nichols, of Cornell University, will deliver a lecture on daylight and artificial illumination.

MUNICIPAL LIGHTING IN LAFAYETTE, IND.—Mayor Dugan, of Lafayette, Ind., is urging the municipal Council to adopt an ordinance providing for the submission of the question of construction of a municipal lighting plant to a vote of the people. He states that the cost of lighting under present conditions for the next 10 years would amount to $172,950, whereas Prof. Esterline has reported that the cost of erecting a city plant complete would be $49,185, and the cost of operation complete would be $8,507 per year. Figuring upon this report, the Mayor estimates that, including interest, the total cost of the plant and operation for 10 years would be $141,764.

WHO IS THE PROFESSOR?—We clip the following from the New York *Sun:* "'Have you noticed,' asked the professor, 'how often you get a slight shock these days whenever you touch the radiator or the gas jet, or any other body of metal? It was not so when we were young. Thirty years ago such shocks required long and industrious tramping up and down the carpet, and could be produced only by certain people. Now they are almost universal after the slightest movement and are felt by every one. The reason is that we use such enormous quantities of electrical force, all of which is dissipated into our surroundings, that everything in a large city gradually becomes charged with electricity. It is not so in the country. If anyone could devise a means of collecting this wandering electrical energy it would be very valuable.'"

PENNSYLVANIA STATE COLLEGE.—Dean J. P. Jackson, of the School of Engineering, of the State College of Pennsylvania, in conjunction with a number of committees, is considering the question of improvements in the present courses of engineering. Among these is the introduction of more work bearing upon the business principles which enter into the transportation and manufacturing problems of the country, and means for encouraging a greater spirit of original independent investigation and research among the students. Efforts are being made to have leaders in Pennsylvania industries visit the college for the double purpose of securing their suggestions as to improvement of its work, and enlisting their interest in the future graduates.

WIRELESS REGULATION.—President Roosevelt in a message to Congress has urged early legislation for the protection of government messages transmitted by wireless telegraphy. The restrictions suggested for enactment into law are intended to apply in times of peace, as during times of war more radical regulations can be put into effect without legislation by means of executive proclamation as a belligerent right of the President. In a letter from the Secretary of the Navy accompanying the message, it is stated that on frequent occasions important messages from war vessels were interfered with and held up for a considerable time by the working of commercial wireless stations. The department asks that it be made a punishable offense to originate or transmit a false message purporting to be official; to break in and interfere with any wireless station while it is transmitting an official message; to refuse to cease or to fail to cease sending a private wireless message when called upon to do so by an operator having an official message to be sent.

LEAD-COVERED CABLES IN DEEP MINES.—A number of years ago F. N. Bosson, electrical engineer of the Calumet & Hecla Mining Company, at Calumet, Mich., attempted to use lead-covered cables in that mine where, on account of the depth of the working, there are some remarkably long runs. For example, in some places the cable would extend a mile or more down a shaft. It was found that the insulation of this cable always broke down and that the break-down invariably occurred at the lower end. The matter was not thoroughly investigated from a purely scientific standpoint at the time, but different construction was adopted to get rid of the difficulty immediately without delay. The usual construction now is to run conductors in extra heavy iron-pipe conduit. Various theories have been advanced to account for this break-down of insulation, the most feasible being that it is due largely to mechanical causes and that there is a creeping of the copper conductor in the insulation when a conductor is hung at an angle of 39 degrees, as in the Calumet & Hecla mine. On long runs of cable this causes a buckling of the copper conductor at the bottom which in some cases has proved enough to break through the insulation.

PITTSFIELD A. I. E. E. SECTION.—The Pittsfield Section of the American Institute of Electrical Engineers has held seven meetings so far this season. The opening meeting was held on Nov. 2, 1907, at which Mr. D. B. Rushmore gave an interesting address on "Institute Work and Policy." At the second meeting, held on Nov. 14, 1907, Mr. H. H. Barnes, Jr., consulting engineer of the New York office of the General Electric Company, delivered an address on "The Practical Side of the Curtis Steam Turbine." The lecture was illustrated with a number of interesting lantern slides. Mr. E. B. Merriam, of the General Electric Company, Schenectady, N. Y., addressed the third meeting on Dec. 6, 1907. His subject was "Some Notes on High-Power Tests." Mr. C. E. Eveleth, of the General Electric Company, Schenectady, on Dec. 20, gave the fourth lecture, his subject being "The Electrical Equipment of the West Jersey & Sea Shore Railway." The fifth meeting, held Jan. 10, 1908, was addressed by Mr. E. E. F. Creighton, of Schenectady, on "Lightning Phenomena and Protective Devices." The section held its sixth meeting on Jan. 24, 1908. This meeting was a departure from the others, in so far as there was no lecture given, it being an informal smoker, at which answers were given to a number of questions which had been handed in previous to the meeting. The chairman called on various members present to reply to the questions, which covered a wide range of subjects. As an experiment the results were satisfactory, and it is probable that similar meetings will be held in the future. The seventh meeting of the season was held on Feb. 6, 1908. Ninety members were present and listened to a very interesting talk by Mr. E. J. Berg upon the "Phenomena Occurring on High-Voltage Power Transmission Lines." Mr. Berg accompanied his remarks with a number of diagrams and gave actual figures obtained by tests made under operating conditions.

Generating Station, Garage and Equipment of the Auto Transit Company of Philadelphia, Pa.

THE Auto Transit Company of Philadelphia began operating a line of electric omnibuses over a six-mile route on Broad and Diamond Streets on July 16, 1907. The route on Broad Street extends two miles either side of City Hall, while that on Diamond Street extends two miles west of Broad Street to the entrance of Fairmount Park. The omnibuses thus pass the Pennsylvania Railroad station, the City Hall and the principal theaters, hotels and public buildings. With the exception of the pavement about City Hall Square, asphalt pavement obtains throughout the route. The electric omnibuses serve a densely populated section of the city and provide a direct and necessary means of transportation between sections more easily reached by this means than by trolley cars.

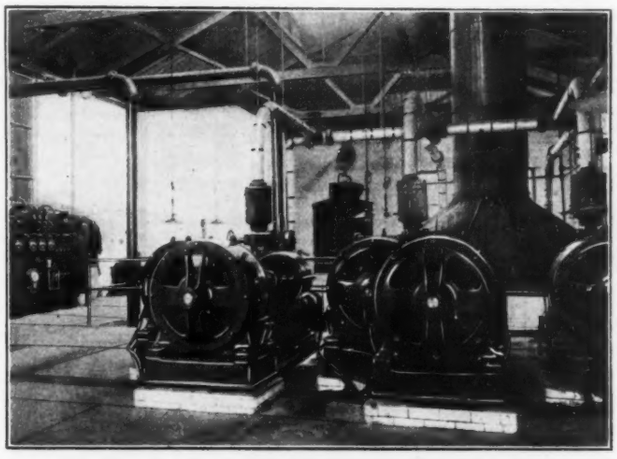


FIG. 1.—GENERATORS AND SWITCHBOARD IN AUTO TRANSIT COMPANY'S CHARGING PLANT.

GENERATING STATION.

The charging station, power plant and offices of the company are located on Thirty-first, Fletcher and Dauphin Streets. The two buildings are divided into a power station, battery department, garage and repair shop. Store rooms and offices are located on the floor above the repair shop at the corner of Dauphin and Thirty-first Streets.

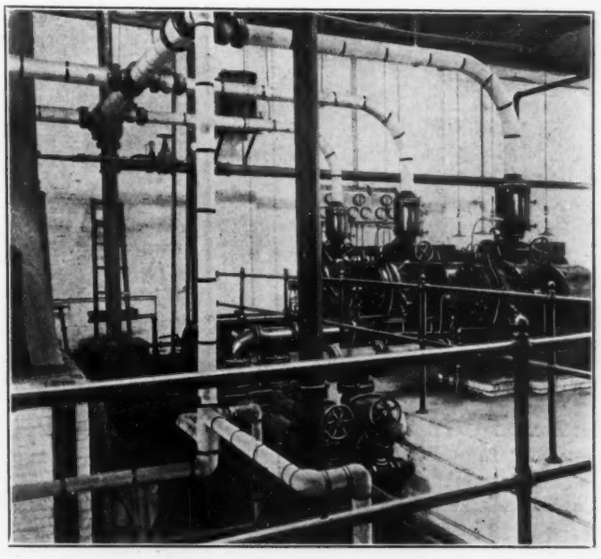


FIG. 2.—VIEW OF POWER PLANT SHOWING COMPACT ARRANGEMENT OF APPARATUS.

The power plant equipment comprises three 150-hp De Laval steam turbines each of which drives a pair of 115-volt, shunt-wound Western Electric generators. The turbines operate condensing on 26-in. vacuum and receive steam from two 175-hp Heine water-tube boilers equipped with grates for burning No. 2 buckwheat coal. Forced draft is supplied by an engine-driven fan. The turbines are guaranteed to show a steam consumption of 30 lbs. per kilowatt-hour output at the switchboard when operating at full load under a steam pressure of 160 lbs. on a 26-in. vacuum. This is a conservative figure, as a test run on 80 per cent load with a vacuum of 25.5 ins., showed a steam consumption a trifle below 28 lbs. The condenser equipment consists of a C. H. Wheeler surface condenser, a "Mullen" patent suction, valveless, vacuum pump, two Wheeler-Pratt cooling towers, one steam turbine-driven circulating pump and one motor-driven circulating pump, the latter being used when one or two engines are running. The feed water for the boilers is passed through a Cochrane feed-water heater.

The layout of the power plant is such that the steam connections are made very simple. The boilers are located in a pit 10 ft. below the engine-room floor. The condenser is also installed in this pit and is set at right angles to the turbine beds, making a very short and compact arrangement of condenser piping as well as convenient connections for the feed-water heater. Fuel is stored in bins under the sidewalk and the daily supply of coal is chuted, through a door in the wall, immediately in front of the boilers, where it is convenient for the fireman to handle it. A Sprague, ½-ton, motor-driven hoist, suspended from an I-beam and carrying a ½-yard dumping bucket, is used to lift the ashes to wagons on the street.

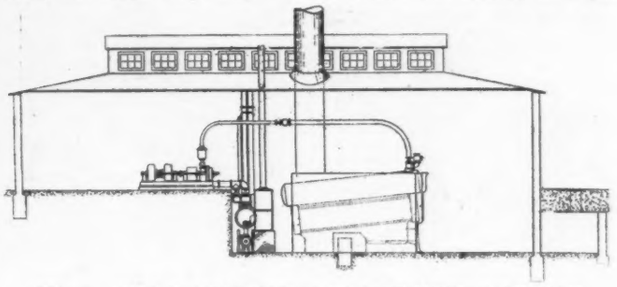


FIG. 3.—SIMPLE ARRANGEMENT OF GENERATING APPARATUS.

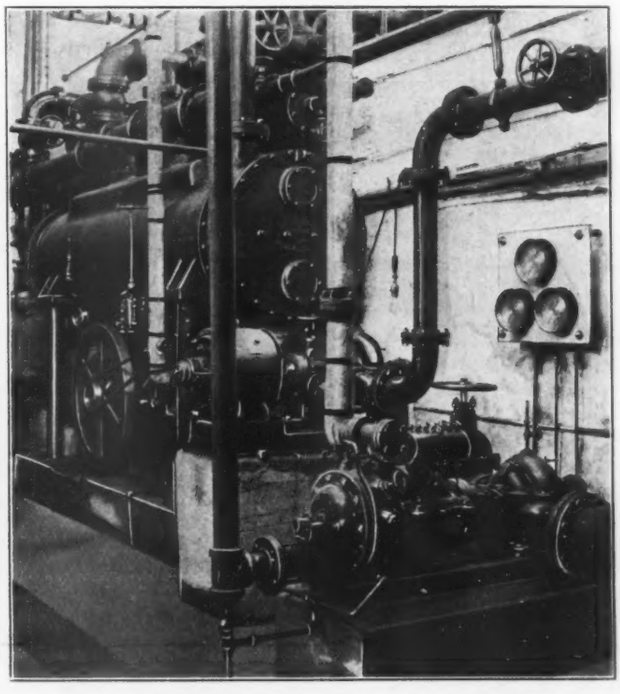


FIG. 4.—CONDENSER EQUIPMENT IN BOILER-ROOM PIT.

The switchboard, built by the Walker Electric Company, is arranged for controlling the six generators. Three generator, one feeder and one distributing panel are provided. Three negative busbars connect the negative side of the line with corresponding bars on the distributing board on a gallery in the battery room through 1,000,000 circ. mil cables. A single positive bus leads directly to the terminal lead for each battery.

BATTERY CHARGING ROOM.

The room devoted to charging and repairing batteries is equipped for handling 80 batteries and space is provided for

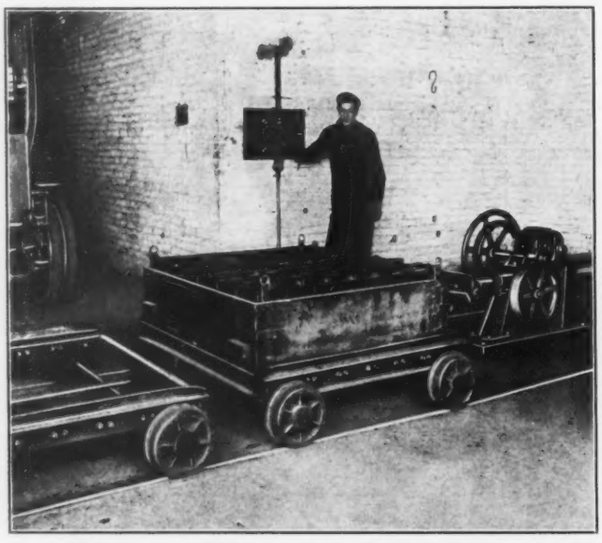


FIG. 5.—METHOD OF INSTALLING FRESH BATTERY IN OMNIBUS.

40 additional batteries. These are placed on timber stands and lead-covered cables are run to each stand. The negative leads are brought from the charging board located on the gallery at one end of the room; while the positive leads are all connected to a common busbar built up of copper strips and mounted on porcelain blocks, the whole being encased in wood boxing. The cables are carried along the floor under the battery

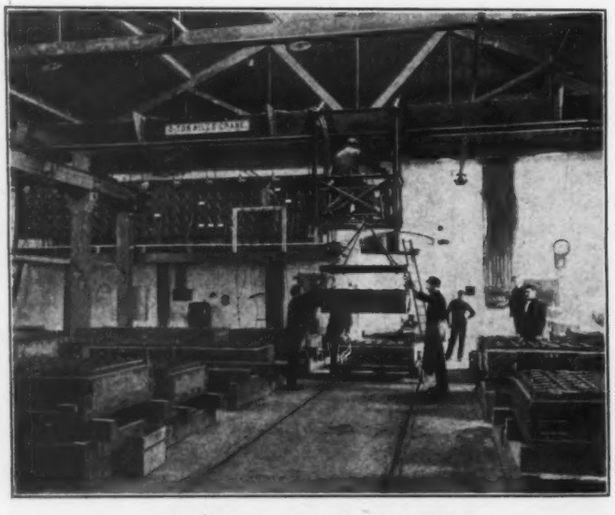


FIG. 6.—BATTERY CHARGING ROOM.

stands and are thus out of the way when the batteries are being shifted.

The charging board is made up of 10 slate panels. On each panel is an ammeter and 12 three-point switches, each of which connects with a battery stand on the floor below. The operator is thus enabled to connect the battery to any desired busbar. The ammeter is arranged with a portable shunt which can be inserted in the clips of the switches in place of the switch blades used for closing the circuit so that the charging current of the battery may be observed, after which the shunt is removed and the switch closed, thus permitting one ammeter to serve the 12 switches and reducing the wiring on the board to the limit of simplicity. Three voltmeters are mounted on one end of the switchboard.

Two methods of charging are in use. In the three-voltage scheme the potential on the three busbars is 90 volts, 100 volts and 110 volts respectively. The battery is connected first to the 90-volt bus until the current decreases to a specified value, when the battery is switched on the 100-volt bus. The battery is finally connected to the 110-volt bus, where it remains until it is fully charged. In the second scheme, sufficient batteries are connected to one bus and one turbine is run under that load until the batteries are fully charged. Once started, little attention is necessary and this is the quickest possible way of charging the batteries. In addition the plan has the advantage

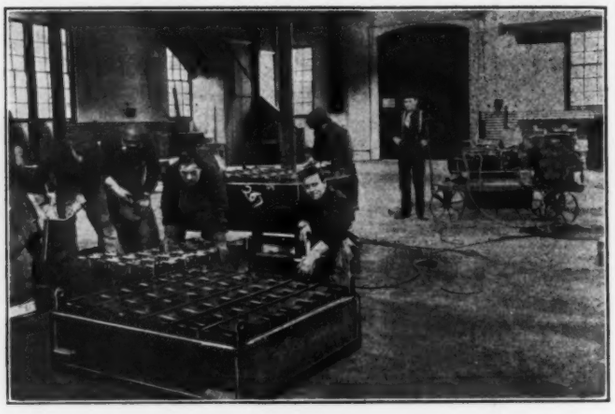


FIG. 7.—BATTERY REPAIRING ROOM.

of keeping the generators fully loaded and is conducive to high efficiency.

The battery room is well ventilated and has practically no exposed iron work. The battery-room floor is of asphalt. The battery trays are handled by a two-ton electric crane. The charged batteries are placed on trucks or cars which are pushed by hand in front of the battery ram. The latter is operated by a ¼-hp series-wound motor. The field coils of the motor are connected in parallel so as to give the motor sufficient torque. A friction nut is placed in the ram gearing

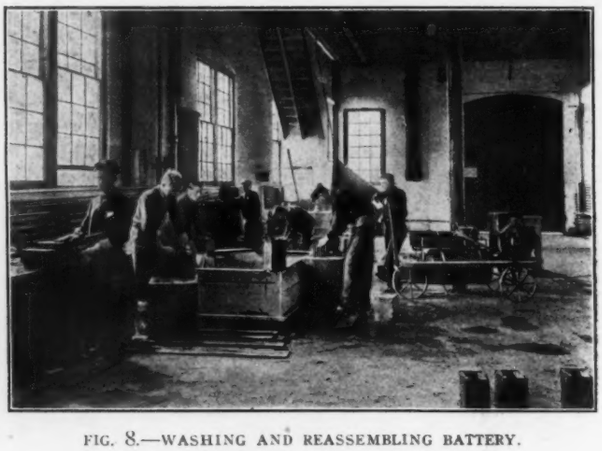


FIG. 8.—WASHING AND REASSEMBLING BATTERY.

to limit the thrust of the ram and prevent injury to either the ram or the battery. The equipment is capable of handling a battery every two minutes, and cranes, trucks and rams are provided in duplicate to guard against delay in case of breakdown.

Distilled water is supplied from the condenser to a cedar tank located over the battery ram and the water is piped to convenient points in the battery room for use in the batteries. The provisions made for washing and repairing the batteries

are clearly shown in the engravings. The storage batteries used are manufactured by The Electric Storage Battery Company, of Philadelphia. Each tray contains 42 cells of type 21 MV, connected permanently in series. The rated discharge of the battery is 70 amperes for four hours. The method of handling the omnibuses as they come in is as follows:

The omnibus is run into a driveway until opposite the ram. In front of the ram is a battery truck or car with a fully charged battery. On the other side of the omnibus and directly opposite the ram an empty car is pushed. The battery in the

FIG. 9.—CORNER OF GARAGE.

omnibus is disconnected from circuit and an operator closes the switch which sets the ram in operation. In one operation the fully charged battery is pushed into the omnibus and the latter battery in turn pushes the exhausted battery out of the other side of the vehicle onto the car placed there to receive it. The connections to the new battery are quickly made and in less time than it takes to relate it the omnibus continues on another trip. The method of handling the batteries is well shown in Fig. 6. Beyond the door may be seen the battery ram and the distilled-water tank overhead. The car in the foreground contains the tray with the exhausted battery from an omnibus.

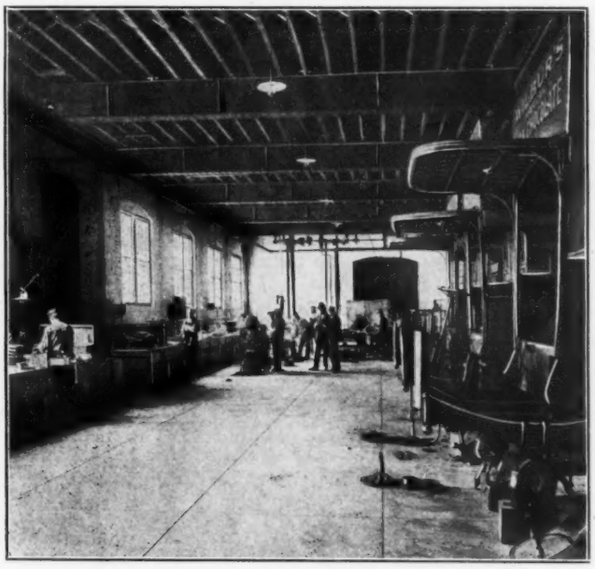


FIG. 10.—VIEW OF AUTOMOBILE REPAIR SHOP.

Immediately back of it is an empty car and the crane is shown in the act of lifting a fresh battery to be placed on the empty car and pushed in front of the ram. Other batteries are shown on charge. The engraving shows the charging switchboard with cards in place on switches controlling the circuits of batteries on charge. The switchboard attendant is shown using the ammeter jack.

Fig. 7 gives a view of the battery department and illustrates the method of assembling the batteries and "burning" the lead connections. In the background is shown a motor-driven air compressor used for supplying air for the hydrogen flame used in "burning" the lead. Fig. 8 shows the batteries being washed and reassembled.

OMNIBUS EQUIPMENT.

The omnibuses, of which there are 25 in use, are of the double deck, London type, seating 34 passengers—18 on cross seats on top and 16 on side seats inside. The vehicles were built by the Commercial Truck Company of America, a Philadelphia concern, and each wheel is equipped with a series motor of special design rated at 22 amperes, 90 volts and 1600 r. p. m. The motor is connected through a 14 to 1 double reduction gear to an internal gear attached to the hub casting of the wheel. The normal speed of the vehicle, fully loaded, is 12 miles an hour on a level street.

The four motors are controlled by a revolving-cylinder controller having street-railway type of fingers. The combinations made are as follows: First notch, four motors in series without resistance; second notch, two front motors in series and in series with two rear motors in parallel with no resistance; third notch, motors in series parallel; fourth notch, motors in parallel with resistance; fifth notch, motors in parallel with no resistance. A bus under ordinary conditions and when fully loaded can travel 30 to 33 miles on a charge; but the trips

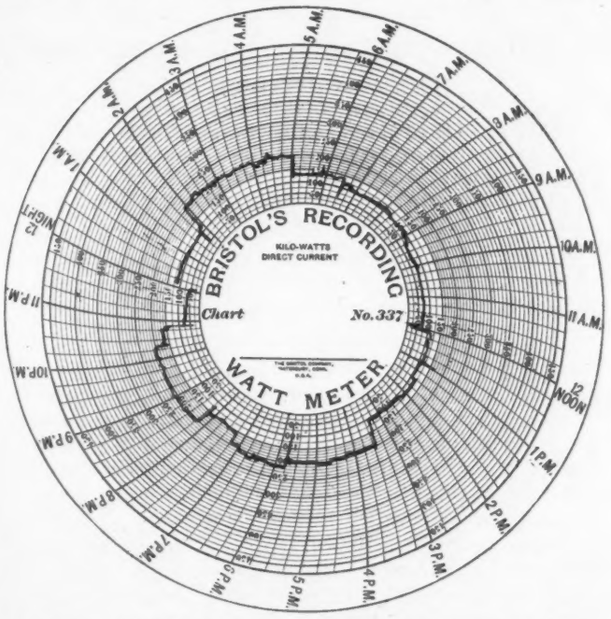


FIG. 11.—WATTMETER CHART SHOWING UNIFORMITY OF LOAD.

are arranged so as to leave a safe margin to guard against the batteries running down while the bus is in regular service. Under the present arrangement the vehicles make two trips on one charge of battery, traveling a distance of 25 miles.

The vehicles are lighted by four 8-cp lamps and two head and one tail lights of 4 candle-power are used to comply with the requirements of the automobile law. The brakes, which are operated by the foot, consist of hard-wood shoes pressing against a cast-steel surface on the hubs of the rear wheels. In addition, the controllers are designed to permit the motors to act as emergency brakes on the first notch with reversed connections in the event of the failure of the foot-brake. No circuit-breaker is used in the motor connections, but a cartridge fuse is inserted in each motor circuit. This fuse is large enough to permit sufficient current to pass for ordinary service and yet protect the motor.

The garage is designed to accommodate 50 vehicles. The omnibuses, when coming in for battery renewals, pass through the garage and give the attendants an opportunity for making close inspections and quick repairs. After the last trip a fresh battery is installed in the battery compartment under the body of the car, after which the vehicle is returned to the garage where it is washed, inspected and put in first-class order before being sent out the next morning. The repair shop is located in the same building with the garage, a room 40 ft. by 128 ft. being provided for that purpose.

The omnibuses operate very closely along street railway lines, the system of accounting being modified somewhat to meet the

changed conditions, due to tires, batteries, etc. The vehicles run on a schedule which requires an average speed of eight miles an hour, and cover about 130 miles a day. Three batteries are allotted to each bus, two being on charge to each battery in service. The vehicles weigh 11,400 lb. and the weight of 'bus per passenger is 335 lb. The percentage of live load to weight of 'bus is 47.5. Compared to a Brill semi-convertible car, seating 40 passengers, the latter weighs 32,000 lb.; has a weight of car per seated passenger of 800 lb., and the percentage of live load to weight of car is 19.7. The accompanying wattmeter chart shows the fairly uniform load and low peak on the station equipment supplying the energy for charging the batteries. Complete records are kept of the wheels and tires, armatures, batteries, etc., in addition to the engine-room log and daily station report.

The station was designed by the staff of the Commercial Truck Company, the builder of the omnibuses. The officers of the company are Mr. H. S. Kerbaugh, president; Mr. J. M. Hill, vice-president and general manager; Mr. S. H. Carpenter, secretary and treasurer; Mr. F. E. Whitney, assistant general manager.

Alternating-Current Generators and Converters.

At the meeting of the American Institute of Electrical Engineers, held on Feb. 14, three papers were presented dealing with central-station and sub-station machinery. A paper by Mr. W. L. Waters discussed the advantageous features of non-synchronous generators. Some developments in synchronous converters were described in a paper by Mr. Charles W. Stone, while a paper by Mr. J. E. Woodbridge outlined certain features of railway converter design and operation.

NON-SYNCHRONOUS GENERATORS.

A non-synchronous generator is in reality an induction motor driven at a speed greater than synchronism. Since the load on an induction motor depends upon its slip, it reverses its sign and increases in the negative direction when the speed is increased beyond synchronism. The machine is not inherently self-exciting, but must be supplied with lagging wattless magnetizing current from a synchronous generator, synchronous motor, or condensers. When a non-synchronous generator is used with a synchronous motor or converter, the voltage of the circuit is determined by the excitation of the synchronous machine. When the load increases, the additional load comes first on the synchronous machine, energy being supplied from the momentum of its rotating part, and then as the machine decreases its speed somewhat, and thereby decreases the circuit frequency, the load is transferred to the non-synchronous generator, the synchronous machine supplying merely the additional lagging current required when carrying the additional load.

Since a short-circuit on a system supplied with energy from non-synchronous generators causes the voltage to drop to zero, there is no tendency to deliver energy to the short-circuit. Moreover, during normal operation a non-synchronous generator acts as a strong damper to remove all harmonics in the e. m. f. wave-form of the system, so that a non-synchronous generator takes no part in the sudden surge of electricity which occurs during a short-circuit.

An equipment consisting of 1200-kw, six-phase, 140-volt, 30-cycle non-synchronous generator transmitting energy to a 1200-kw synchronous converter has been used successfully during the past three years by a copper smelting and rolling company for obtaining 6000 amperes direct current at an e. m. f. of from 100 to 230 volts. This equipment combines the flexibility of the standard direct-current or alternating-current generator with the overload range of the synchronous converter, and the reliability and robustness of construction of the induction motor.

SYNCHRONOUS CONVERTER DEVELOPMENTS.

In the paper by Mr. Stone it was stated that, although most of the larger systems using synchronous converters operate at 25 cycles, 60-cycle converters, even when used for 600-volt railway work, can be considered thoroughly reliable, machines rated as high as 1500 kilowatts being in successful operation.

A recent improvement in the design of synchronous converters has been in the use of the vertical in place of the horizontal shaft.

The vertical-shaft converter occupies less floor space than a horizontal-shaft machine. Moreover, it is possible to walk around the machine and examine and adjust all of the brushes on both the commutator and the collector rings without climbing over a bearing-pedestal or descending into a pit. The shaft, unlike that of the horizontal-machine, is stationary; in fact, it is merely a pedestal supported on and fastened solidly to the foundations.

Among the devices for regulating the e. m. f. delivered by a synchronous converter may be mentioned variable-rated transformers, series inductive reactance, induction regulator in the supply leads, and direct-connected alternating-current booster. The most recent development, which is unlike any other scheme, was first proposed by Mr. J. L. Woodbridge, and improvements have been introduced by Mr. J. L. Burnham. In this method advantage is taken of the fact that the ratio of conversion between the alternating and direct e. m. fs. can be changed by varying the distribution of the magnetism over the field poles. Each pole is divided into two sections, each containing its own winding. The winding on the larger section corresponds to the main shunt winding on an ordinary synchronous converter, while the regulation is obtained by changing the excitation of the smaller, the m. m. f. being in one direction to raise the e. m. f. and in the other to lower it.

DESIGN AND OPERATION OF RAILWAY CONVERTERS.

Mr. Woodbridge stated that there are now in service in this country synchronous converters having an aggregate rating of nearly 1,000,000 kilowatts, about one-third of which is in six-phase machines. The advantage of the six-phase over the three-phase converter resides in the greater output from the same winding, and a more even distribution of the losses in the coils. A three-phase machine may safely be increased in rating by from 40 to 50 per cent with no increased losses, and with a correspondingly higher efficiency by the addition of three or more collector rings.

The relative disadvantage of the higher number of phases are the increased number of parts of the machine and possibly some little additional complication of the transformer circuits. If the reactive coils or other devices are serially connected in the six-phase circuits, these need be, and commonly are, only three-phase.

About 50 per cent of the railway converters in use in this country are started from rest by the direct application of alternating e. m. f. at reduced value to the collector rings. With an e. m. f. 25 per cent of normal value, the machine at rest will take about twice full-load current; that is, 50 per cent of full-load volt amperes. The machine accelerates to synchronism as an induction motor. In actual service 25-cycle converters rated at less than 500 kilowatts are usually started from mid-taps in the transformer windings and reactances, which consume 15 per cent of the normal voltage when carrying full-load current, are connected in series in the collector-ring circuits. The starting voltage for 25-cycle converters rated at more than 500 kilowatts is usually one-third of normal.

Converter equipments are commonly designed for delivering a constant direct e. m. f. when the resistance loss in the line is 10 per cent. The author stated that in general for such service the total reactance in circuit should be such as to give a 25 per cent inductive voltage at full-load, and the series turns on the field coils should be such that the m. m. f. balances about one-half full-load armature ampere-turns, with the transformer ratios such as to give normal direct e. m. f. with about one-quarter full-load current (lagging) at no-load; the converter field rheostats should be set for normal direct e. m. f. regardless of the power-factor, and the main station e. m. f. should be kept constant at such a value as will give unity power-factor at about one-half load on the converter.

Methods of Testing Igniting Apparatus.--II.

BY F. W. SPRINGER.

IN a previous article the measurements of resistance and magnetic flux were described in detail, together with the measurement and calculation of the self-induction of coils and armatures. In what follows the various other measurements necessary to the proper testing of ignition apparatus are taken up and the subject concluded.

CAPACITY OF CONDENSERS.

The capacity can be calculated from the dimensions. Thus,

$$C = \frac{K A N}{4 \pi d \ 900{,}000} \text{ micro-farads,}$$

in which C is the capacity in micro-farads. K is the dielectric constant (varying from 2 to 2.3 for paraffined paper, about 6 for common window glass, and 6.6 for mica); A is the area of one side of one sheet of the dielectric which is covered by one side of one condenser plate or sheet of tinfoil; N the number of active sheets of dielectric, and d the thickness of the dielectric, all values being expressed in the c. g. s. system. (In Fig. 1 the condenser has five active sheets of dielectric.)

A condenser consists of 11 sheets of paraffined paper, .0075 cm thick, is covered by tin foil sheets 50 cm long and 7 cm wide. Then,

$$C = \frac{2 \times 7 \times 50 \times 11}{4 \times 3.14 \times .0075 \times 900{,}000} =$$

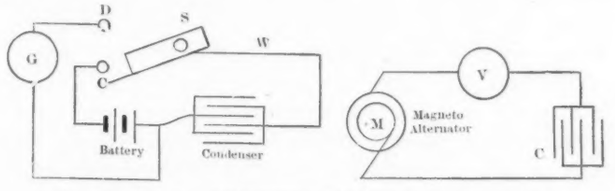
$C = .09$ micro-farad.

The "free discharge" capacity of a paper condenser will be about 30 per cent less than the above-determined value owing to the dielectric absorption of paper.

Since the "free discharge" capacity of a condenser for an induction coil is its useful working capacity, the wiping contact method should be used in comparing the capacity of a condenser with that of a standard.

The method consists in charging the condenser by making a "wiping" contact with a set of cells and then immediately, by continuing the motion of the switch or key made in charging, discharging the condenser, by a second "wiping" contact, through a ballistic galvanometer. Ordinarily the contact should be made for about .01 second.

The deflection being made while using a standard condenser of known capacity and charged with the same set of cells, the capacities of the two condensers are in the ratio of their respective galvanometer deflections. Referring now to Fig. 1, the switch S or a well-insulated wire, W, is "wiped" not too



FIGS. 1 AND 2.—MEASURING CAPACITY OF CONDENSERS.

quickly against the contacts C and D to charge and discharge the condenser, respectively. The discharge, of course, passes through the ballistic galvanometer, G. A standard mica condenser should first be used, then the spark-coil condenser. A 0.1—mf standard condenser gave a deflection of 7.42 cm and a spark-coil condenser 6.35 cm.

The capacity of the latter was,

$$.1 \times \frac{6.35}{7.42} = .086 \text{ micro-farad.}$$

In case a large number of condensers are to be tested for their capacity, as in factory work, the method indicated in Fig. 2 may be used. In Fig. 2 M is a magneto-alternator—such a machine may easily be constructed by putting one slip-ring on a direct-current magneto-generator and grounding the other side of the circuit on the armature shaft. The magneto-alternator should be run at a constant speed. Any source of alternating current, however, such as a lighting circuit, may be used. V is an alternating voltmeter and C is the condenser to be compared. The larger the capacity of C, the greater will be the reading of the voltmeter V. The latter should be calibrated by using at C a standard condenser of adjustable capacity.

NUMBER OF TURNS OF WIRE ON COILS.

The diameter of the wire being measured by means of a micrometer, caliper or wire gage, the resistance being measured, the total length of wire can be found from a copper wire table; knowing the average length of one turn, the number of turns can be calculated.

The flux ϕ and the coefficient of self-induction L being known, the number of turns can be calculated from the equation

$$L = \frac{\phi N}{10^8 I} \text{ in which } L, \phi \text{ and } I \text{ are known.}$$

For example, a coil, of which L = .25 henry, had 15,400 lines of force when the current was .8 amp.

$$.25 = \frac{15{,}400 N}{10^8 \times .8} \text{ hence } N = 1300 \text{ turns.}$$

When L_p and N_p of one coil and L_s of the other are known, both coils being on the same core, N_s can be calculated at once.

$$\frac{L_p}{L_s} = \frac{N_p^2}{N_s^2} \ ; \ \frac{.004}{25} = \frac{220^2}{N_s^2} \text{ hence } N_s = 17{,}600 \text{ turns.}$$

If there are two coils, the number of turns of one of which is known, or if it is possible to wind on a temporary coil having a known number of turns, current may be sent through first one coil and then the other, so that the flux is the same in the two cases. The relative number of turns will be inversely proportional to the currents used, thus,

$$\frac{N_1}{N_2} = \frac{I_2}{I_1}, \text{ and } N_2 \text{ may thus be calculated.}$$

BATTERY TEST.

A short-circuit test is the most effective to use to determine the internal resistance and depolarizing qualities of cells. For this purpose one cell, or a number of cells connected in series, should be short-circuited through an ammeter. Thus, if the open circuit e.m.f. of one cell is 1.41 volts, and the short-circuit current 25 amperes, the internal resistance will be $1.41 \div 25 = .056$ ohm.

In case of several cells in series, the short-circuit current will be a little larger than for one cell, owing to the fact that the ammeter resistance will be relatively smaller per cell than with a single cell.

The rate at which the current decreases in value with time is a measure of the depolarizing power of the cells. Moreover, the rate at which the cell voltage returns to its original open-circuit value is a measure of the strength of the depolarizer.

A good method for testing cells is shown in Fig. 3, in which R is any convenient resistor, such as an iron wire, adjusted in resistance to limit the current to a reasonable amount. Suppose, for example, the e. m. f. of five cells on open circuit to be $1.4 \times 5 = 7.0$ volts, and on closing the circuit, $V = 5.5$ volts, when $I = 4.5$ amperes,

$$\text{Then, } R_1 = \frac{V_1 - V_2}{I} = \frac{7. - 5.5}{4.5} = .33 \text{ ohm.}$$

$$\frac{.33}{5} = .066 \text{ ohm internal resistance per cell.}$$

The polarization may be measured as above by taking the readings of V_2 and I after a definite time, then calculating the resistance plus the polarization. The difference between this and the true resistance as determined above will be the polarization as expressed in ohms. The polarization may also be ex-

pressed in terms of the time taken for the current to fall a certain amount when the cell is discharging at a certain rate. A five-ampere discharge rate is approximately correct for comparative polarization tests.

It should be noted, however, that the decrease in current due to polarization is caused first by a counter e. m. f. set up by the products of electrolysis of the discharging current, and also by the reduction of the effective area of the carbon electrode of the cell. The latter is due, in a common dry cell, to the deposit of hydrogen gas which prevents liquid contact with the electrode and thus increases the internal resistance.

Life tests may be conducted by continuously discharging the cell through a resistance and taking readings of the current, and the e. m. f. with closed circuit, and occasionally observing the e. m. f. with open circuit, in order to calculate the internal resistance and to note the polarization, until the cell is exhausted. The average current multiplied by the time of discharge gives the ampere-hour output capacity of the cell. The output capacity will vary greatly with the rate at which the cell is discharged, being larger at the lower discharge rates. The internal resistance and polarization will increase with the time of discharge and the open circuit voltage of the cell will decrease. Sixty ampere-hours is the ordinary output capacity of an ignition battery.

Curves may be plotted with time as the abscissas and e. m. f., current, resistance and polarization, watts, etc., as the ordinates, thus graphically showing the condition of the cell throughout its life.

Service tests of cells are generally made by noting the change in resistance, polarization and e. m. f. of the cells while in

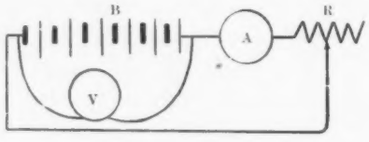


FIG. 3.—BATTERY TEST CONNECTIONS.

actual service. In general, the amount of service of a set of cells can be fairly expressed in terms of the amount of engine fuel consumed.

GENERATOR TESTS.

The resistance of the armature, brushes and contacts may be measured by the well-known ammeter-voltmeter method.

The commercial efficiency of magneto and other direct-current generators can be most easily determined by the "constant-loss" method as follows:

The resistance of the armature, *Ra*, should be observed at the normal running temperature. The generator should then be run without load at the desired speed and field excitation, the volts and amperes being observed, such e. m. f. being impressed on the armature as will give the desired speed. Suppose the resistance *Ra* to be 2 ohms, the voltage e. m. f. to be 30 volts, speed 2000 r. p. m., and the current 1.2 amperes. Then the efficiency when the current output of the machine as a generator is 3 amperes and the output voltage, *E*, will be,

$$\text{Efficiency} = \frac{E \times 3 - 30 \times 1.2 - 2 \times 3^2}{E \times 3}$$

The output voltage *E* must be measured by trial when the current is 3 amperes, or any other desired value.

A motor to drive the generator can be calibrated by the "constant-loss" method described above.

The speed-voltage characteristic of a generator is determined by measuring the open-circuit voltage of the armature of the machine while running at different speeds. All magneto-generators give an open-circuit voltage which is strictly proportional to the speed.

The current-voltage characteristic may be found by running the armature at the normal, or any desired, speed and measuring simultaneously the voltage and the armature current. An adjustable resistance must be connected in the armature circuit to vary the current. The voltage will usually fall off very rapidly as the armature current is increased, due to the resistance of the armature and to the demagnetizing and distorting action of the armature m. m. f. upon the poles.

The safe current output of the generator may be ascertained by running it at the desired speed, connecting a resistance in the armature circuit so as to limit the current to the desired amount and then noting the rise in the temperature of the machine above that of the surrounding atmosphere. The temperature can be observed by means of an ordinary thermometer laid on the armature poles, etc., and covered with putty. This test will require a run of from two to three hours. The safe current output will decrease greatly with increased speed and field excitation.

COMPARATIVE TESTS OF IGNITION SYSTEMS.

It is very essential in making a comparative test of igniting devices to maintain constant engine conditions. One of the best ways in which to do this is to connect the two sets of coils, batteries, etc., to the two ends, respectively, of a double-throw switch, the middle one being connected to the engine. Either igniting set can then be used by quickly throwing the switch, without stopping the engine or changing any of the conditions, and the differences can be noted in the operation of the engine, such as change in speed, power, etc., with different throttle openings, variable back pressure, different amounts and kinds of fuel, different speeds, loads, etc.

Service tests consist in a long time test of an igniter under the varying conditions of service, to determine the reliability, wear, temperature rise, battery demand, etc.

The oscillograph method is excellent for observing the performance of spark coils, etc. In case it is not convenient to make oscillograms while the coils are in service, use may be made of a spark-gap having a greater length than that of the spark plug by an amount depending upon the ratio of the engine compression pressure to the pressure of the atmosphere.

IGNITER LAG, NUMBER OF SPARKS PER SECOND AND SPARK DURATION.

The above quantities may be observed by means of the oscillograph or by the falling-plate tuning-fork method. Another method is to lead the spark-current circuit to the rim of a revolving wheel or to the end of a spoke and to note the spacing of the sparks while the wheel is in motion; the duration of the sparks will also be shown by this method. There will, however, be no indication of the igniter lag.

By mounting two spark-gaps upon the same wheel, one a little nearer the axis than the other, a very satisfactory comparison of the sparking characteristics of two coils might be made except in regard to their igniter lags.

The sound of the buzzer may be compared with that of a tuning fork having a known number of vibrations, and the frequency may thus be determined. The frequency will vary between 85 and 250 per second.

THE ENERGY OF THE SPARK.

The spark energy can be roughly determined by inserting paper in the spark-gap and noting the size of the puncture or the readiness with which the paper is inflamed. The most accurate method is one involving the use of the oscillograph for comparing the sparks.

QUANTITY OF ELECTRICITY.

The quantity of electricity per spark can be determined by measuring the average current taken by a jump-spark coil while continually buzzing. This current divided by the number of vibrations per second will give the ampere-seconds, or coulombs used per spark. In the case of a touch-spark coil, or non-vibrating jump-spark coil, the average demand made upon the battery or generator may be measured by an ammeter placed in the battery circuit, and this value divided by the number of sparks per second as determined by the engine speed and number of engine cylinders, will give the coulombs. There is, of course, one spark for every two revolutions in a four-stroke cycle engine.

The quantity of electricity per spark may be determined by

measuring the area of an oscillogram of the primary or the secondary current. This is the only method that can be used in case of secondary currents.

ESTIMATION OF CURRENT DEMANDS AT DIFFERENT ENGINE SPEEDS.

If the steady-current demand of a vibrating jump-spark coil and the *arc of contact* in per cent of one engine revolution are known, the average current demand at any speed will be equal to the above per cent multiplied by the steady-demand current. At very high speeds, however, many timers are subjected to a slightly decreasing arc of contact owing to "throwing off" of the contact members of the timer. Moreover, in case the time of contact is so short that the time is equal to that of, for example, 1½ coil vibrations, there will be a decrease in current-demand with increase of engine speed. If the *"duration of the time of contact"* is a constant one at all speeds the average current demand will increase directly as the speed.

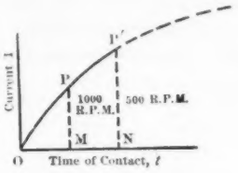


FIG. 4.—CURVE OF CURRENT INCREASE.

With touch-spark coils, the demand will increase as illustrated in Fig. 4, in which it may be supposed that the primary break comes on the straight part, *OP'*, of the current-time curve at all speeds considered, the area *OPM*, divided by the time, being the average current demand at 1000 r. p. m., and *OP'M* at 500.

The area of *OPM* is one-fourth of that of *OP'N*, but there are twice as many sparks at 1000 as at 500 revolutions, hence doubling the speed will decrease the average current demand by one-half when the arc of contact is constant. This also applies to non-vibrating jump-spark coils.

In case the *"duration of the time of contact"* is constant at all speeds the average current demand of vibrating and non-vibrating jump-spark coils and touch-spark coils will increase as the engine speed increases.

MAXIMUM VOLTAGE.

There is only one practical method of measuring the intermittent maximum voltage of a jump-spark coil. (The average value of this voltage as measured by a static voltmeter has little significance.) An adjustable needle-pointed spark-gap should be connected in parallel with the spark-plug gap and the needle-gap should be decreased until the sparks are shunted from the spark plug. The battery circuit should be disconnected during each adjustment. The needle-gap distance corresponds to a definite voltage, as shown in the curve of Fig. 5. For example, .2 in. corresponds to 5000 volts, at atmospheric pressure. The rupturing voltage increases with the atmospheric pressure and with the bluntness of the points.

SPARK PLUGS.

The voltage necessary to break down the insulation of a spark plug may be applied and measured as described above. The spark-plug gap must be lengthened and perhaps insulated with mica in order to conduct the test.

The equivalent jumping voltage of a spark plug may be observed as indicated above.

ENGINE TESTS.

The best way of observing the varying speed of an engine is to drive a direct-current magneto-generator from the engine, and to connect an adjustable voltmeter resistance and voltmeter in series with the magneto. The resistance may be set so that, for example, an indication of 6 or 60 on the voltmeter scale corresponds to a speed of 600 r. p. m. as determined by a speed counter. All other speeds will vary proportionally with the voltmeter readings.

Angular velocity variation will not, as a rule, have any effect upon the ignition. A test for such variation, however, may easily be made by covering the periphery of the flywheel with smoke from a candle and causing a vibrating tuning fork to move across the face of the flywheel so that a wavy line may be traced, by a stylus, in a spiral around the wheel. The tuning fork should be placed in a tangental position to the wheel.

There is no simpler or better method for measuring the steady power output of an engine than that of the common Prony brake. If, however, one is observing slight changes in the operation of the engine in connection with the test of coils, etc., the following is by far the best method. The method consists in belting the engine to a generator of suitable rating, preferably separately excited, and measuring the total armature current, I_a, field exciting current, I_f, speed of the armature, S, and voltage, E, at the brushes of the generator. The latter is preferably measured by placing the voltmeter leads directly upon the commutator opposite the middle points of the brushes.

The horse-power, P, of the engine may be calculated as follows:

$$P = \frac{I_a E + W + I_a^2 R_a + \text{belt loss}}{746}$$

in which W is the watts (as measured by an ammeter and a voltmeter) required to run the armature of the dynamo without a belt as a motor at the same speed and with the same field current as when the reading I_a and E in the above equation were taken. W includes all of the constant losses of the dynamo when running either as a generator or as a motor.

$I_a^2 R_a$ is the watt loss in the armature, R_a being the resistance of the armature between the voltmeter terminals, measured at the same temperature as that at which the readings for the horse-power were taken. The belt loss is usually very small.

The measurements of the temperature, specific gravity and quantity of the fuel, although simple enough, are quite troublesome. Probably the best way is to observe the temperature by means of an ordinary thermometer inserted in the feeding bottle. The latter consists of a plain glass bottle with straight sides, calibrated in cu. cm, or 1/1000 of pints, out of which the fuel is siphoned to the carburetor. The bottle

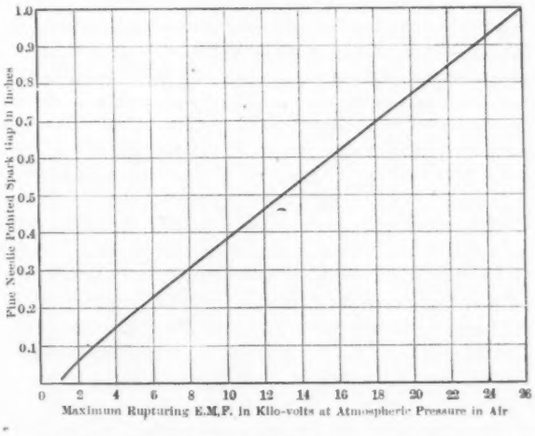


FIG. 5.—SPARK DISTANCES CORRESPONDING TO DIFFERENT VOLTAGES.

should be of such a size that a good reading of fuel consumption can be made during a two-minute or a three-minute run.

The specific gravity, the weight and the volume of the fuel can be ascertained at once by weighing a quantity of the fuel in a bottle of known weight, filled to a mark on the neck of the bottle. This result may then be compared with the weight of the bottle, filled with water to the same height. A gasoline hydrometer may also be used for determining the specific gravity.

The speed of inflammation of the charge can be measured photographically, or by means of a high-speed pressure indicator, such as the manometer.

The Luminous Properties of Conducting Helium.*

By P. G. Nutting.

A GAS conducting an electric current radiates the energy imparted to it by the current. Neglecting relatively very slight losses, the efficiency of such a gas as a transformer of electrical energy into radiation should approach unity in value. Radiation from a gas should then be expressible in terms of current and other specificable conditions with considerable precision. To express this radiation in terms of light, the spectral distribution of the radiation and the visual sensibility of the observer must be known.

The results here presented relate to the amount of light emitted laterally per unit length by a column of helium gas carrying a known current. The chief object of the investigation was to determine the constancy and reproducibility of such a source of light and the specifications most favorable to constancy and reproducibility.

Conducting helium emits light of a yellowish-white color, which is better for photometric comparisons with a glow lamp than is that from any other of the permanent gases. Next best is perhaps carbon-dioxide. This emits a snow white light, but it decomposes and disappears rapidly even with moderate current densities. Sulphur vapor emits bluish-white light, but its density is difficult to measure and control. Helium has the further great advantage of not disappearing rapidly as other gases do when conducting a heavy current. The life of a tube of helium is at least 50 hours, as compared with half an hour for a similar tube of hydrogen or nitrogen carrying the same current.

Preliminary tests with tubes of various forms led to the adoption of a simple straight form, with disc electrodes. The electrodes are of aluminum 1.5 mm. thick and 25 mm. in diameter, in spherical bulbs 35 mm. in diameter. The bulbs are connected by a straight piece of capillary tubing 50 mm. in length and 2 mm. in internal diameter. Foil 5 mm. wide was wound about each end of the tubing to give the light emitting portion a definite measurable length. Light from the bulbs was screened off from the photometer.

Ordinary methods were used in filling, but extra precautions were taken to free the electrodes from hydrogen. The tubes were cleaned with chromic acid and water, and exhausted with a Geryk oil pump. After from 20 minutes to an hour of steady pumping with heavy current running through the tube, the last trace of hydrogen disappeared. Then helium was admitted, its pressure adjusted to about 5 mm. by means of an oil manometer of special design, and then the tube was sealed off. A mercury pump or McCleod gage cannot be used on account of the contamination of the helium by mercury-vapor.

The tubes were operated at about 5000 volts by alternating current from a transformer, the e. m. f. of which was controlled by using resistance in its primary circuit. The light emitted was compared with that from a calibrated 4-cp incandescent lamp by means of a Lummer-Brodhun photometer of the equality type. The uncertainty in each determination is about 2 per cent, the probable error being less than 1 per cent. In a spectrophotometric comparison, the uncertainty would have been from 10 to 50 per cent on account of the variable width of the lines.

The variation of light with the current in various forms of tube is shown in the accompanying table and curves. The light from the whole capillary tube, when stationary, is given in candles, but the value is uncorrected for mean horizontal equivalent.

The plotted curves indicate the effect of a change in the size of capillary tubing. Tube No. 18, with its small bore, gives a curve much steeper at the start, but early approaching a maximum. Tubes of larger bore give curves of less curvature.

The variation of light with the potential gradient was studied with the purpose of expressing the light emitted in terms of the rate of absorption of energy. Auxiliary potential electrodes of platinum wire were inserted at each end of the capillary portion of the tubes, and potential readings were taken with a multicellular voltmeter. By this means fairly constant potential readings could be obtained. It was found, however, that by playing a flame or blast of cold air upon the capillary tube, a variation of 5 to 10 per cent in the indicated fall of potential could be produced. This variation, however, was not accompanied by a variation in the light emitted, so long as the current was held constant.

*Abstract of a paper appearing in the *Bulletin of the Bureau of Standards.*

TABLE I.—VARIATION OF TOTAL CANDLES WITH CURRENT

Tube No.	Bore mm.	Length mm.	CURRENT IN MILLI-AMPERES							
			10	15	20	25	30	35	40	45
18	1.2	40	0.58	0.94	1.19	1.33	1.39	1.42	..	..
27	1.8	54	0.55	0.86	1.16	1.45	1.71	1.92	2.11	2.30
43	3.12	50	0.29	0.68	0.96	1.23	1.47	1.69	1.89	2.09
39	2.17	49	0.60	0.92	1.23	1.54	1.83	2.06	2.30	2.53

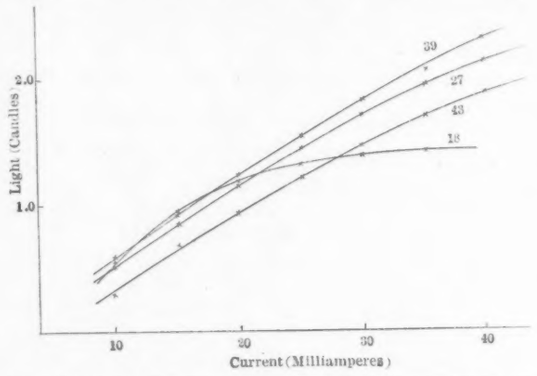


FIG. 1.—VARIATION OF LIGHT WITH CURRENT IN DIFFERENT TUBES.

TABLE II.—VARIATION OF POTENTIAL GRADIENT WITH CURRENT

	Current in Milli-amp.	Light in Candles	Potential Gradient	Watts consumption	Candle per watt	Watts per candle
Tube No. 38 operated at pressure of 4.2mm. of Hg.	10	0.60	274	2.74	0.219	4.57
	15	0.86	256	3.84	0.227	4.40
	20	1.21	245	4.90	0.246	4.07
	25	1.50	237	5.92	0.253	3.96
	30	1.76	233	6.99	0.258	3.88
	35	2.00	231	8.10	0.247	4.05
	40	2.24	230	9.20	0.244	4.11
	45	2.46	229	10.30	0.239	4.19
Tube No. 43 Pressure 5.0mm. of Hg.	10	0.39	233	2.33	0.169	5.92
	15	0.68	211	3.16	0.215	4.65
	20	0.96	198	3.96	0.242	4.14
	25	1.23	190	4.75	0.259	3.88
	30	1.47	185	5.55	0.265	3.78
	35	1.69	180	6.30	0.268	3.74
	40	1.89	176	7.04	0.268	3.74
	45	2.09	173	7.79	0.268	3.74
	50	2.28	170	8.50	0.268	3.74

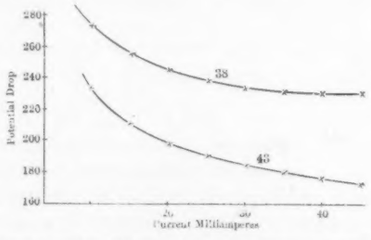


FIG. 2.—VARIATION OF VOLTAGE WITH CURRENT IN DIFFERENT TUBES.

Some typical results are given in the accompanying tables and curves.

The two curves for fall of potential plotted against current are of the typical form for the anode column of a conducting gas. That for the larger capillary tube is lower and on a larger scale. These curves are of very nearly the same form for all pressures from 2 mm. to 10 mm., but are a few per cent higher, because the higher pressures of the auxiliary electrodes took up the actual potential of the gas. The above data give an indication of the luminous efficiency of such a tube. It passes through a maximum at a current density of about 6 milli-amperes per sq. mm. The low luminous efficiency of helium is due largely to the three infra-red lines at 728, 1117 and 2040 $\mu\mu$, which represents at least 90 per cent of the total radiation without contributing to the light emitted.

The variation of the light emitted with the density of gas

TABLE III.—VARIATION OF LIGHT WITH GAS PRESSURE AT VARIOUS CURRENTS IN TUBE NO. 38.

Current Milli-amp.	GAS PRESSURE IN mm. OF Hg.					
	9.0	7.7	5.8	4.2	2.8	1.9
10	0.38	0.55	0.55	0.55	0.48	0.08
15	0.70	0.87	0.91	0.90	0.83	0.66
20	0.98	1.22	1.24	1.24	1.20	0.91
25	1.25	1.51	1.54	1.54	1.54	1.24
30	1.48	1.79	1.83	1.85	1.86	1.51
35	1.72	1.99	2.10	2.10	2.10	1.71
40	1.96	2.20	2.31	2.35	2.07	....
45	2.11	2.35	2.47	2.56	2.58	....

was studied by means of tubes of three different diameters filled with helium at pressure ranging from 2 mm. to 10 mm., and carrying currents from 10 to 45 milli-amperes. Gas pressure was measured on a special manometer containing gas-free pump-oil of one-fifteenth the density of mercury. Each tube was first filled with pure gas at the highest pressure, then the pressure was reduced in steps by temporarily connecting with a highly exhausted auxiliary bulb of the proper size.

The complete results with tube No. 38 are reproduced in Fig. 3 with a curve dotted for tube 43 and one for tube 45. The curves for the 2-mm tube are parallel with the pressure axis over a wide range of pressure and current. For the 3-mm tube the curve is higher at lower pressures; for the 1-mm tube it is higher at high pressures.

Both direct and alternating current at high and low frequency

TABLE IV.—VARIATION OF LIGHT WITH GAS PRESSURE AT VARIOUS CURRENTS IN TUBE NO. 43.

Current Milli-amp.	GAS PRESSURE IN mm. OF Hg.				
	8.5	6.6	5.0	3.7	2.5
10	0.13	0.26	0.41	0.42	0.33
15	0.34	0.52	0.71	0.74	0.65
20	0.53	0.82	1.01	1.03	0.92
25	0.74	1.09	1.29	1.34	1.20
30	0.92	1.31	1.54	1.58	1.53
35	1.11	1.60	1.77	1.79	....
40	1.31	1.71	1.98	1.99	....
45	1.46	2.01	2.20	2.07	....
50	....	2.12	2.40	2.17	....

and voltages were used with the apparatus unchanged. Direct-current at 1000 volts, obtained from two 500-volt generators in series, could be adjusted at 22.5 milli-amp. and at 23.7 milli-amp. Afterward the more easily adjustable alternating current was brought to these values. (See Table V for results.)

The slight differences observed are less than the uncertainty in the light determinations.

The light emitted by a tube varies with its orientation, on account of irregularities in the bore. Heavy walled tubing is worst, deviations of 10 per cent from the mean horizontal being not uncommon. Walls 1 mm thick are sufficiently strong for such tubes, and such thin walled tubes if carefully selected are found to give deviations of only one or two per cent from the mean. Such deviations are of slight consequence when the mean horizontal candle-power is obtained.

The diameter of the bore affects the light emitted per unit length with a given current. Tests indicated that in such a luminous column of gas practically all the radiation comes from within half a millimeter of the surface so that the light

TABLE V.—EFFECT UPON LIGHT EMITTED OF CHANGING THE NATURE OF THE CURRENT.

Nature of Current	LIGHT EMITTED	
	22.5 Milli-amp.	23.7 Milli-amp.
Direct, 1000 volts	1.21	1.30
Alt. 60 cycles, 2000 volts	1.22	1.28
Alt. 60 cycles, 5000 volts	1.22	1.29
Alt. 900 cycles, 5000 volts	1.21	1.29

emitted varies with the area of the longitudinal section rather than with the volume. The current density varies inversely as the square of the diameter, so that if the light varied directly as the diameter (at constant current density), as above indicated, it should vary approximately inversely as the diameter at constant current. Results are available for four different bores of tubes at 25 milli-amperes of current.

When properly plotted these four points lie near a smooth curve that is nearly a straight line.

In the light of the above results, the specifications most

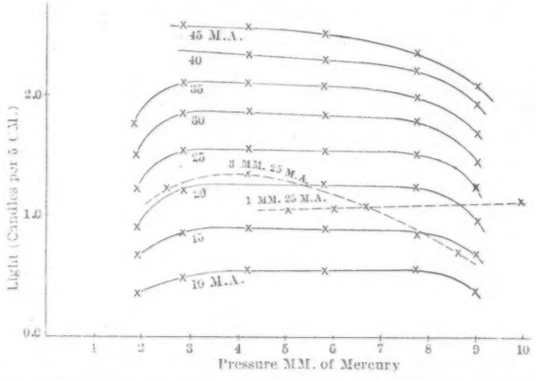


FIG. 3.—VARIATION OF LIGHT WITH GAS PRESSURE AT DIFFERENT CURRENTS.

suitable for constancy and reproducibility in a helium standard of light intensity may be drawn up, namely, a current of 25 milli-amperes, a bore 2 mm. in diameter and a gas pressure of about 5 mm of Hg., which need not be accurately known. Conversely it might be stated that a tube having a capillary of 2-mm bore, filled with pure helium at 5-mm pressure, will emit N mean horizontal candles per centimeter of length when

TABLE VI.—VARIATION OF CANDLE POWER WITH DIAMETER OF BORE.

Diameter of bore, in mm.	1.029	1.949	2.168	3.120
Mean horizontal Cp. per Cm. at 25. Milli-amp.	0.365	0.325	0.311	0.259

carrying a current of 25 milli-amperes. The constant N has been shown to be very nearly a linear function of current and bore, and nearly if not quite independent of other small variations. The uncertainty in the value of N, aside from the uncertainty in its photometric determination, is very small, probably much less than one per cent in the mean.

To test the reproducibility, a set of six duplicate tubes were made up with a mean internal diameter of 2.168 mm and filled at 5 mm pressure. These gave the following values in mean horizontal candles per cm length at 25 milli-amperes.

The greatest deviation is only about one per cent, the aver-

age deviation less than one per cent and the probable error in the mean value less than one-third of one per cent.

The correction for the bore of the tube is 0.009 from the curve of variation of light with bore, so that this set of tubes gives for the value of the constant N, 0.337 candle per centimeter.

Incidentally, many tests for a time effect were made. At the end of a long series of observations with varying current of orientation, tubes would be brought back to the initial current or position and their light values checked with previous ones made half an hour before, and with others made a week

TABLE VII.—REPRODUCIBILITY OF HELIUM GAS LAMP AS LIGHT STANDARD.

Tube No.	Candles per cm.	Deviation from mean
37	0.325	−0.003
38	0.329	+0.001
39	0.332	+0.004
40	0.328	+0.000
41	0.326	−0.002
42	0.326	−0.002
	Mean 0.328 ±0.001	0.002 mean deviation.

or a month previously. In every case values checked up to within the uncertainty of observation. In the few cases where apparent changes were recorded the change was large and due to an obvious change in the tube itself, a crack or the development of hydrogen or a cathode deposit due to excessive current.

These results are so promising that the helium tube seems to be worthy of consideration as a primary light standard. Its freedom from the troublesome atmospheric corrections to which the Hefner, Carcel and Pentane standards are subject, are very much in its favor. The only quantity to be measured while in operation is the current, and this may easily be determined with the required precision.

The uncertainties in the value of the light constant N are of three classes and these require further investigation before the helium tube may be considered as a competitor of existing standards.

These uncertainties are:

1. Separate determinations by the same observer on the same tube. These are not serious, being of the same order as the uncertainties in ordinary photometric work.

2. Uncertainties due to using different tubes. Reproducibility will require further investigation with tubes made of different kinds of glass and of different diameters. If this uncertainty is no greater than is indicated by the test of the six tubes Nos. 37 to 42 above recorded, it is of little consequence.

3. Uncertainties due to varying the observer on account of color differences. These are perhaps the most serious of all and will require careful investigation by many different observers.

Light and Color in Decoration.

At the meeting of the New York section of the Illuminating Engineering Society, held on Feb. 13, the newly elected chairman, Mr. W. W. Freeman, presiding, Mr. George L. Hunter presented a paper dealing with light and color in decoration, the presentation being accompanied with lantern demonstrations in color. Mr. Hunter stated that he could not understand why so much effort is being exerted to illuminate interiors without wasting light on ceilings, walls or refractors. To illuminate a room is the same thing as to light its walls, ceiling and furniture, and the light thus used is not wasted. It is the reflecting surface or refracting medium that makes the light useful by changing its composition and lessening its intensity. The reflected or refracted light has lost some of its colors, but the colors that remain are those that identify the thing seen and make it visible. Often ignorance of the importance of walls and ceiling in light distribution leads to serious and expensive error. In many of the so-called highly efficient lighting systems the reflectors and refractors of various types have succeeded in taking the light from the ceiling and upper walls that can distribute it effectively, and in concentrating it on the floor where it is objectionable.

A small room of good proportions with light walls and ceiling is beautifully illuminated by two 16-cp lamps suspended from the center of the ceiling about 6.5 ft. from the floor. In large rooms the light of lamps as low as that would strike the eye unpleasantly, especially as their power would of course be greater. Only in rooms with high ceiling where the lamps can be hung high is the use of powerful units permissible. The permissible candle-power of the light source is directly regulated by the height of the ceiling. In a huge auditorium like that of Madison Square Garden, lamps of enormous power can be effectively used. In interiors with low ceiling the units must be kept small.

Another way of preparing light for the eye is to refract it through frosted opal or mosaic glass, or through crystal beads or prisms. This turns the lamp from something to be avoided into something that the eye likes to look at, and at the same time it transforms glare into diffused light. The refractors play the same part as ceiling and walls, and would help to illuminate even a room in black velvet. The use-efficiency of a lamp that distributes light cannot be compared on the basis of photometric tests. The light that counts is the light that is actually employed in the revealing of objects to human vision.

The color of lamp shades and refractors is highly important. Those in golden yellows, ambers and light-browns are safe almost anywhere. In a red room, blue or green shades should never be used, nor red shades in a green room. Rooms finished in dark colors are almost impossible to illuminate brilliantly, and look best when kept comparatively dim. Whether the room be light, or dark, the material of the lamp standards and fixtures should never be dark enough to contrast strongly with the lamps.

The best than can be done in a room with dark walls and ceiling is to use small units generously distributed and enclosed in globes or crystals that are competent to break up the light and distribute it without mural assistance. To direct all the light to the floor—although this does produce high photometric tests in the plane of illumination—is to apply to general illumination principles that are properly applicable to local illumination only. Even in local illumination the light reflected from book or embroidery is much more agreeable if it has been subdued before reaching the object illuminated. The printed page that shines beneath the light reflected down from the white polished surface of a tin desk shade is not lighted efficiently, though invariably lighted too much. A smaller amount of light from an opal globe or frosted bulb is infinitely preferable.

DISCUSSION.

The discussion was opened by Mr. H. F. Huber, who outlined in a convincing manner the difficulty arising from the lack of co-operation between the architect, the decorator and the illuminating engineer, each one attempting to outdo the work of the other and make his own especially conspicuous. Satisfactory results will be obtained only when all persons interested in the illumination work together in harmony to produce the most efficient and pleasing final result, without regard to the credit that each will get for his part in the undertaking.

Dr. H. H. Seabrook discussed the color sensations recorded by the eye and showed why certain combinations are effective and pleasing while others produce the opposite effect. These effects have been investigated mathematically on the wave-frequency basis and some of the most surprising results have thus been thoroughly explained.

Mr. E. Y. Porter stated that the law of inverse squares does not apply the diminution of the sensation of excessive brilliancy as the distance between the eye and the lamp is increased. In fact, throughout a considerable range the eye recognizes the intensity as equally disagreeable independent of the distance.

Dr. Louis Bell said that many of the colors that the eye

classifies as pure are in fact made up of several colors, so that the exact effect of illuminating a surface of a certain color with a light of known composition cannot always be predicted. Erratic color combinations are frequently found in decorative materials.

Mr. A. J. Marshall called attention to the present method of transmitting intelligence through printed matter where the words which are to be observed are printed in black (which cannot be seen) on a white background (which alone is visible). He expressed the opinion that except for the seeming novelty of the arrangement better effects upon the eye would be produced by printing the words in white upon a black background.

Conduit Construction.

Mr. Bernard C. Groh, formerly conduit engineer of the American Telephone & Telegraph Company, and now engineer of the American Conduit Company, at Chicago, presented a paper before the Chicago section of the American Institute of Electrical Engineers, Jan. 21, on "Telephone Conduit Construction." In opening he referred to the former opposition of telephone engineers to placing telephone cables underground, which still existed as late as 1895. These objections are of considerable historical interest, as they enable us to form an idea of the great development and change since then when we consider the enormous number of wires in underground telephone cable at present. In a conduit with an interior diameter of 3 or 3¼ ins. a cable containing 300 pairs of No. 19 B. & S. conductors or a cable containing 600 pairs of No. 22 conductors can be placed. One of the larger telephone companies has successfully experimented with a cable containing 900 pairs of No. 25 conductors.

In 1884 the Board of Electrical Control of New York City, realizing the necessity of underground construction to do away with the increasing number of overhead wires, held a conference with the representatives of the principal electrical companies of the country. At this conference over 600 patents and plans relating to the subject of underground electrical construction were examined. Many were discarded, but a number were actually tried. One proposed method experimented with was to surround a collapsible mandrel with concrete, the mandrel being collapsed and withdrawn after the concrete had set, thereby providing a monolithic concrete subway. This method has again been experimented with within the past year by engineers connected with the construction of the tunnels under the North River between New York and New Jersey.

In the tunnels it is very difficult and undesirable to cut out the concrete lining should the conduits upon completion be found imperfect, and extra precautions are taken that the alignment of the concrete conduits shall not be disturbed by the placing of the concrete. In this work a collapsible mandrel 50 ft. long was successfully used. One was placed in each duct before the concreting was begun and then removed to be used over again after the concrete had hardened. One method tried by early experimenters was to place concrete around zinc tubes instead of removable mandrels. This system was unsuccessful on account of the weakness of the zinc tubes, which not only became dented, but corroded and fell in strips into the conduit. A number of other unsuccessful systems were described.

Cement-lined pipe until recently was extensively used for underground work. This consists of a thin sheet-iron tube lined with cement, the tubes being 8 ft. long and the cement lining about ½ in. in thickness. While this type of conduit has been reasonably successful, there is a chemical action between the alkali of the concrete and the lead sheath of the cable which gradually decomposes the lead. The best-known types of conduit extensively used to-day are creosoted wood, single and multiple vitrified clay, fiber and artificial stone. Up to a short time ago creosoted wood duct was made almost exclusively from short leaf yellow and Norway pine. These woods are sufficiently porous to take the oil well. On account of these timbers becoming scarce, experiments have been made with other woods.

Wood duct, after being sawed and bored, is placed in sealed tanks, where the sap and moisture are exhausted. Then a certain amount of dead oil of coal tar is pumped into the tank under pressure. The chief requirements in the dead oil of coal tar are 40 per cent of naphthaline, no acetic acid or acetates and as small a per cent of tar acids as is commercially practicable. The naphthaline is the principal preservative. Acetic acid attacks the lead sheath and in time forms white lead. It is impossible to obtain dead oil of coal tar without some tar acids, but this amount can be as high as 8 per cent without danger to the lead sheath. The usual amount of tar used per cubic foot of timber is 15 lb. on the average, the sap wood taking more and the heart wood less.

Vitrified clay conduit is made of a special kind of clay finely ground and then burned until vitrified. All surfaces are covered with a soft glaze. The most desirable clay for conduit contains alumina, silica, lime and iron. The lime and iron assist in the vitrification. The color of vitrified clay is due to the presence of iron, the red clay showing a higher oxide, and yellow a lower oxide. When both lime and iron are present, the color of the duct is almost black. The conduit, after being formed from the plastic clay, is placed in a drying room for several days until thoroughly seasoned. It is then placed in the kilns and fired. The fires are started gradually and do not reach their maximum heat for about two days. They are kept at this point for approximately two days more, during which time the contents of the kiln are at white heat. Then the heat is reduced and common salt is thrown on the fire, which forms a glaze on the conduit. The kiln is then allowed to cool. In all, the conduit is in the kiln about a week.

Fibre conduit is made up from paper saturated with a preservative compound. There are two types of this conduit on the market. One type is formed directly from paper pulp by special machinery, the pulp being rolled while wet in very thin layers on a mandrel until the desired thickness of wall is obtained. The pipe is then removed from the mandrel and thoroughly dried, after which it is dipped in a compound similar to natural asphalt. After cooling, the ends are provided with the joint desired. In making the other type of fibre conduit, paper is passed through a bath of hot bituminous compound in such a way that it is thoroughly saturated. It is then, while still hot, rolled on mandrels which form it into conduit. When cooled, it is ready for the desired cutting of the joints at the end.

Outside of real estate, a conduit system is conceded to have the longest life of any portion of a telephone plant. In engineering studies, a 50-year life is assumed. It is, therefore, advisable to give much thought to planning the underground portion of the plant. The most economical arrangement of conduit leads will usually be found to be a gridiron with a single base line passing the central office parallel to the longer dimension of the blocks. Irregularities in streets and districts will usually require a departure from the ideal layout. It will usually be found advisable to parallel existing conduit which is too small with one on another street rather than to enlarge the existing run.

Owing to the nature of the work, considerable time is consumed in wheeling and placing the concrete after it has been mixed. Therefore, a cement with a considerable period of time between the mixing of the water and the initial set is desirable. For this reason Portland cement is usually employed in conduit work. In the past it has been the practice to employ a stronger mixture than experience has proven can be justified. It has been found that a mixture of 1—3—6 or 1—4—8 is of sufficient strength for conduit work, and a 1—2—5 is usually recommended for manhole walls and roofs. Sand should be reasonably clean. Few specifications now require "sharp" sand. Gravel is usually treated the same as crushed stone in conduit specifications. It is claimed that gravel concrete will have greater ultimate strength, while crushed stone will show greater strength on short-time tests.

Where considerable digging is anticipated close to a conduit containing important cables, concrete on the sides of the structure is desirable for any conduit except creosoted wood. Fibre and single artificial stone ducts are laid in practically the same encasement of concrete as single or multiple vitrified clay, with the exception that on account of the long lengths in which these materials are supplied, the concrete base is frequently omitted. The circular cross-section of these materials and the fact that they are usually installed with a separation between each conduit results in an inverted concrete tunnel construction with vertical webs, which many engineers consider afford sufficient strength in itself to warrant the omission of the concrete base, thereby effecting a material economy in the cost of the structure. In suburban districts where streets are not congested with underground structures, concrete manholes will usually prove the more economical. In congested districts where the shape of the manhole has to conform to the conditions encountered, thereby prohibiting the use of standard forms, brick manholes will be more desirable. This is especially true where future alterations are likely to be required in a manhole. The conduit should be so graded as to drain into the manholes. It is not necessary to provide a continuous grade from manhole to manhole so that a candle held in the duct of one manhole is visible from the other, as has been specified in a few comparatively old telephone specifications and is to-day specified in government work. The conduit can be crowned at any part of the section between manholes and allowed to drain into the manhole at each end if economy in excavating can be effected by so doing.

Meter-Testing Regulations.

The past few years have witnessed the passage of abundant laws and measures, the appointment of public utilities commissions, etc., for the regulation of public service companies. The rates that electric light companies may charge for electrical energy have been fixed in many states by statute and various rules for the guidance of the customer and lighting company alike have been promulgated. The meters maintained by electric light companies have always been and probably always will be, next to the rates, the center of attack, and for that reason the rules relating to the testing of meters in some of the states and in Canada are given in brief herewith:

In Massachusetts a customer of an electric light company or the company itself may apply to the Board of Gas and Electric Light Commissioners for an examination and test of any meter in use, the board furnishing the applicant with a certificate of the result of the test and the expense attached thereto. If the meter is incorrect, the board may order the company to correct it or substitute a correct meter for it. All fees for examinations and tests are paid by the applicant, and if the examination is made at the request of the customer and the meter is found to register too fast, the electric light company pays the fees to the board, to be repaid by it to the applicant. The meter is deemed to be correct if it does not vary more than 5 per cent from the standard approved by the board. The inspector employed by the board receives a salary, together with necessary traveling and other expenses. The aggregate amount, however, must not exceed $3,000 in any year. Should the amount of compensation and expense exceed the amount of fees received, the excess is assessed and recovered from the electric light companies. The board establishes rules and regulations, fixes standards, prescribes fees, and employs such means and methods in connection with examinations and tests of meters as in its judgment are most practicable, expedient and economical. The fees charged for the testing of various sized meters are given in the accompanying table.

In Wisconsin a commission provides for the examination and testing of any and all appliances used in measuring electricity, and any consumer may have such appliances tested upon payment of the fees fixed by the commission. As in Massachusetts, the fee is paid by the consumer at the time of his request, but it is paid by the electric light company to the commission to be repaid to the consumer if the appliance is found to be defective or incorrect, to the disadvantage of the consumer.

In New York, under the old laws, every meter in New York City was supposed to be tested; but because of the great expense attendant thereto, this was found to be impracticable and meters were tested only upon complaint. In order to secure impartiality, an arrangement was made with Columbia University to take charge of all meter testing. This work was done under the supervision of Professor Sever, and the university was paid $1,500 a year. In order to have a meter tested, the complainant sent $2 to the Department of Water, Gas and Electricity, and if the meter on test was found to be more than 4 per cent fast, the fee was returned to the complainant, but if the meter was found to be slow, the fee was retained by the department. According to C. F. Lacombe, the engineer for the department, 106 meters had been tested during the year, most of which were found to be accurate. Seventy-five per cent of those found to be inaccurate were slow, and of those found to register too fast, the extra registration of the fastest meter tested was found to be 16 per cent.

By the provisions of the Canadian law, a meter must be tested and stamped every five years. The meters to be tested are brought to the government inspection office, and in small towns and villages the test is conducted on the premises of the electric light company. When a customer desires his meter to be tested, he notifies the electric light company to that effect, requesting it to send a qualified person to detach the meter from the mains so that it may be taken to the inspector's office. The inspector files with either the electric light company or the purchaser on payment of the proper fee a certificate stating the result of the inspection, with such other particulars as he may deem right to insert for the information and guidance of the persons concerned. Electrolytic meters at present in use may be continued unless objected to by the purchaser, but all renewals of meters must be made by the substitution of direct-reading types. No meter is passed which, when working at its full rating, varies more than 3 per cent from the legal standard unit of electricity, in favor of either the electric light company or the consumer. Whenever a reading of a meter is taken by the electric light company, the company must give a duplicate of such reading to the consumer. In every case the owner must keep the meter in good repair and is responsible for the due inspection thereof. There are numerous penalties in force for persons who knowingly repair, tamper with or alter meters.

RATES FOR TESTING WATT-HOUR METERS.

Meter Rating.	New York.	Massachusetts.	Canada. Lamps.	Canada. Motors.
3 amp.	$1.00	$1.50	$0.75	$3.00
5 "	1.00	1.50	.75	3.00
10 "	1.50	1.50	1.25	3.00
15 "	2.00	2.00	1.75	3.00
25 "	2.50	2.50	2.75	3.00
50 "	3.00	3.00	3.50	3.00
75 "	4.50	3.50	5.00	6.00
100 "	5.50	3.50	6.50	6.00
150 "	8.00	4.00	9.00	9.00
200 "	10.50	4.50	11.50	12.00
300 "	15.50	4.50	16.50	18.00
450 "	23.00	5.00	24.00	27.00
600 "	30.50	5.00	31.50	32.00
1200 "	60.50	....	61.50	72.00

New Telephone Patents.

TWO-WIRE CIRCUIT SYSTEMS.

In some systems, instead of the usual single common battery, supplying all lines alike, several different batteries are used to supply current for different functions. In one of these the division of current between two batteries is according to calling and called lines; the one being supplied from its battery and the other from a second distinctive battery. Such systems have in some instances been subject to many disagreeable clicks due to the transfer of the lines from battery to battery. To avoid this there has been devised a new arrangement of the circuits

whereby this shifting of batteries is overcome. H. M. Post, of Chicago, has obtained a patent for such an arrangement with a three-wire multiple, and W. W. Dean for a two-wire multiple, both patents having been assigned to the Kellogg Switchboard & Supply Company. In both, the live or ungrounded side of each battery is connected into the line signal circuits. The relays of these circuits are then so arranged as to perform different functions, according to whether the line happens to be a calling one or a called one, in each case causing the proper arrangement of circuit to meet the corresponding side of the cord circuit. The changes of circuit are effected without abrupt changes of battery conditions in the talking circuits.

CALLING SWITCH FOR INTER-COMMUNICATING SYSTEM.

Mr. A. K. Andriano, of San Francisco, has invented a selecting switch for use in connection with desk stands, for intercommunicating systems. The idea concerns the use of the home lines of the two stations involved in any connection to pair together as a metallic circuit. The main improvement lies in the restoration of the circuit conditions to normal upon the return of the receiver to the hook without the necessity of restoring the switch. Mr. Adriano's patent is assigned to the Direct-Line General Telephone Company.

LETTER TO THE EDITORS.

Noisy Operation of Dynamos.

To the Editors of Electrical World:

SIRS:—In view of Professor Craighill's article on "Noisy Operation of Dynamos," in the issue of Feb. 1, it may be of interest to readers to know that this same subject has been treated in the *Zeitschrift für Electrotechnik* (Vienna), issue of June 5, 1904, by Mr. J. Fischer-Hinnen, whose formula for quiet operation, transcribed into the designations used by Mr. Craighill, reads:

$$\frac{AB - .7\tau}{P} = K + 0.5$$

The rounding off of the pole corners is taken care of by the term $.7\tau$, whereas Professor Craighill writes $.81\tau$; otherwise the formulas are identical.

This formula has been tested on 25 machines, with the result that the average of 13 noisy machines satisfied the equation:

$$\frac{AB - .7\tau}{P} = K \pm .1$$

and the average of nine quiet machines the equation:

$$\frac{AB - .7\tau}{P} = K \pm .5 \pm .1$$

There are exceptions to this rule, as shown on three machines, which, however, had an unusually great number of armature teeth per pole.

The acoustic experiment to show the connection between speed, number of slots and the pitch of the note emitted by the machine, as described by Professor Craighill, has also been carried out by Mr. Fischer-Hinnen. He observed that a machine of 1070 r. p. m. = 17.8 r. p. s. emitted the note G_2 sharp. This note, lying between G_2 and A_2 corresponds to $\frac{792+880}{2} = 836$ vibrations per second, as derived from the tables given in the articles of both authors. Per armature revolution there are 836:17.8 = 47 vibrations, corresponding to the 47 slots, which the armature had. Another experiment was made on a machine running at 1400 r. p. m. = 23.46 r. p. s., which was found to produce the note A_2 sharp. The corresponding number of vibrations per second is 935, the average of $A_2 = 880$ vibrations and $B_2 — 900$ vibrations per second. Per revolution there are $\frac{935}{23.46} = 40$ vibrations, corresponding to the 40 armature teeth which the machine possessed.

Professor Craighill reports that a 47-slot armature, running at 1125 r. p. m. = 18.75 r. p. s. emitted the note A_2 with 880 vibrations per second. The vibrations per revolution amounts to $\frac{880}{18.75} = 47$. Two other machines he mentioned had a 40-slot armature, revolving at 660 r. p. m. = 11.0 r. p. s. and produced the note A_1 with 440 vibrations per second. The number of vibrations per revolution, therefore, are $\frac{440}{11} = 40$. These results show a remarkable agreement of both authors.

JAMAICA PLAIN, MASS. FRED. E. MEURER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Heat Conductivity of Iron Stampings.—T. M. BARLOW.—An illustrated paper read before the Birmingham section of the (British) Institution of Electrical Engineers. The object was to determine the heat conductivity of assembled insulated iron stampings, first in a direction parallel to the plane of their surfaces, and second in a direction at right angles to their surface through both iron and paper. The coefficient of heat conductivity is defined numerically as the quantity of heat which flows per unit time through unit area of a plate of unit thickness, having unit difference of temperature between its faces. From the measurements of the author the coefficient of heat conductivity for iron laminations in a direction parallel to the surface of one stamping was found to be 0.1405 and in a direction at right angles to this surface 0.00137. From these figures it is possible to calculate the ratio of the sides of two square surfaces in order to dissipate the same amount of heat, one being the edged surface of a packet of stampings and the other being the plane surface of the outside stamping of the packet. This ratio is found to be 10. The results emphasize the importance which should be given in dynamo design to the amount of edged surface of the stampings of a laminated iron core exposed to a cooling medium. The temperature gradient is almost a straight line in a direction with the plane of the stampings. Thus the internal temperature of the core is quickly reduced if the method of cooling employed, either air or oil, is used on this edge surface. On the other hand, if the iron laminated core is only cooled on the plate surface, the temperature will rise, comparatively very rapidly as the core is penetrated across the iron and paper. This rise amounts to as much as 5 degs. C. for a distance of 2 cms. for an induction of 10,000 lines per cm² at 50 periods in the iron for which the curves are plotted. The effect of this steep temperature gradient in an iron core thus cooled is the increase of the hysteresis loss in the center portion due to the decrease of the permeability of the iron with the rise of temperature. Also for any iron rectangular laminated core, which is heated internally, the ratio of the linear dimensions of the sides of the core, i. e., edge side to plate side, for the most efficient cooling must equal 1:10. This ratio is somewhat higher than is used at present in common practice, the figure averaging about 1:6 for small armature cores and transformers, and 1:7.5 for large cores. Further, dealing with the question of the ventilation of direct-current armatures, it will be noticed that the ventilating ducts between the packets of iron stampings are not so useful on account of the extra plate surface exposed to the cooling draught induced, but act more as an outlet for the air inside the center space of the armature which has been heated in cooling the inside edge surface and so the internal parts of the core. This also applies to the ducts in large transformer cores cooled by a direct air blast.—Lond. *Elec. Eng'ing*, Jan. 23.

Commutation.—R. Rüdenberg.—The commutation in dynamos depends essentially on three different things: First, the magnetic phenomena at the armature circumference determine the value of the e. m. fs. induced in the short-circuited coils; second, the conditions of electric resistance, etc., determine the variation of the short-circuit current in time; thirdly, the thermic effects of the short-circuit current at the brushes manifest themselves to the outside. While we have not yet any exact knowledge of the heat phenomena at the commutator, there is available a long series of investigations of the magnetic and electric phenomena. In former investigations, however, the treatment of the electric or magnetic phenomena has been restricted to an investigation of the short-circuited coils themselves, although their connection with the non-short-circuited active armature wires is also of great influence on commutation. The author pays special attention to this point in order to lay the foundation for a more complete theory of commutation. For calculating the e. m. f. of self-inductance of the short-circuit currents the primary flux is divided into three fluxes. One encircles the front connections of the armature winding; the second passes through the armature iron and when leaving it passes only through the short-circuit zone; the third one passes through the active wires at the armature circumference. The short-circuit current is considered as the sum of a current which changes in linear relation with the time, and an "additional current" component. All three fluxes mentioned before determine the self-induction of the "additional" short-circuit current, while the linearly varying current component is determined only by the fluxes around the front connections and in the short-circuit zone. It is not necessary that the short-circuit currents pass completely through the commutator brushes, since there is also a branch circuit open through the armature and the external circuit which prevents an excessive increase of current density below the brushes. The self-induction of this armature circuit is of importance for the commutation, and the spark limit is beyond that which is found by the calculations used heretofore. The fundamental formulas of the commutation problem are given.—*Elek. Zeit.*, Jan. 23.

Lamps and Lighting.

Determining the Distribution of Light from a Lamp.—W. Voege.—While the integrating photometer of Matthews or the spherical photometer of Ulbricht permit the determination of the mean spherical candle-power of a lamp by a single measurement, they give no indication of the distribution of light around the lamp, although this is of great importance for illumination purposes. To make photometrical tests under different angles against the horizontal plane is a most tedious and inaccurate method. An attempt to carry a selenium cell around a lamp and measure the change of its resistance was unsuccessful. The author then devised a method which he has found quite suitable for practical use and which is very simple, being based on the use of a thermo-cell. The thermo-cell is mounted on a stand and is gradually carried around the lamp and the deflection of the galvanometer needle is noted. A curve of this kind may be plotted in a few minutes with great exactness. By changing the arm on which the thermo-cell is mounted and by changing the glasses which are placed before the thermo-cell, the same instrument may be used for low-candle-power incandescent lamps as well as for arc lamps. It is of importance that the distance of the thermo-cell from the lamp is not too small in comparison with the dimensions of the lamp. It is of fundamental importance that the thermo-cell measures the total radiation and not the radiation within the visible spectrum. The author, therefore, absorbs the dark heat rays by placing thick, clear glasses before the thermo-cell. The light rays pass through and among those, the red rays will have the greatest effect on the thermo-cell. It would, therefore, be impossible to use a thermo-cell for absolute measurements of candle-power. But if the ratio of radiation within the visible spectrum to total radiation has the same value at every point of the lamp, the energy values measured in this way will be proportional to the energy within the visible spectrum. This is, for instance, the case with electric incandescent lamps in which the whole surface of the filament is on the same status of incandescence. But care must be taken that the distance of the thermo-cell from the lamp is so large that the length of the filament is small compared with this distance. If by means of an optical photometer the candle-power of the lamp is measured in a suitable direction (for instance, the horizontal candle-power), the figures of the energy curve may be easily changed into figures of candle-power. The author states that he has made this method also suitable for arc lamps by placing besides the clear glasses a green glass before the thermo-cell. This absorbs the greatest part of the red light rays. Since the red rays have a small effect on the eye but a great effect on the thermo-cell their absorption diminishes this source of error. The sensitiveness of the thermo-cell remains nevertheless sufficiently large. In his tests of arc lamps he uses a clear glass of 3 mm thickness and a light green glass of 1.5 mm thickness before the thermo-cell. He further places a collecting funnel before the thermo-

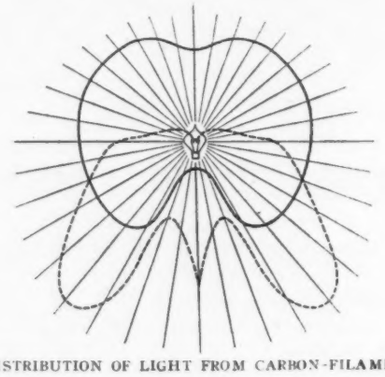


FIG. 1.—DISTRIBUTION OF LIGHT FROM CARBON-FILAMENT LAMP.

cell which concentrates the different rays emitted from the lamp under a certain solid angle onto the thermo-cell so that the latter measures a mean value. Numerous experiments have shown that with arc lamps a correct picture of the distribution of light is obtained in this way, especially if the arc lamp is tested with a globe. A simple method of control is to replace the green glass by a red glass. The new curve obtained must then be quite similar to the other one. Fig. 1 gives the results

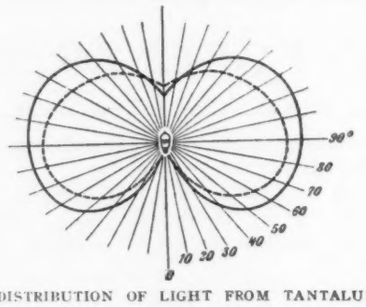


FIG. 2.—DISTRIBUTION OF LIGHT FROM TANTALUM LAMP.

for the tests of a carbon-filament incandescent lamp. The drawn-out curve gives the light distribution around the original lamp with clear globe, while the dotted curve gives the distribution of light, after the upper half of the lamp has been silver-plated. Fig. 2 gives the light distribution of a tantalum lamp; the drawn-out curve referring to a plain, clear globe and the dotted curve to a frosted globe. The difference between both curves is small. It is, however, of importance whether the filament is mounted a little higher or lower within the globe. In this test the filament was a little higher in the frosted globe than in the clear globe. Several curves of arc lamps are also given and a simplification of the method is described in which the deflection of the needle is automatically registered. For this purpose the arm which carries the thermo-cell is provided with a sensitive paper disc within a box. The latter has a single slit through which the light enters. When the arm with the thermo-cell and photographic paper is carried around the lamp, the light distribution curve is automatically

registered on the paper. By an obvious modification of the method it is possible to use it for registering the degree of uniformity of arc lamps. Fig. 3 shows the variation of candle-power obtained with an ordinary direct-current arc lamp of

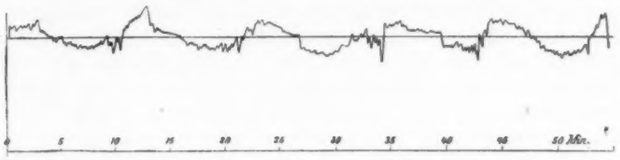


FIG. 3.—VARIATION OF CANDLE-POWER FROM ARC LAMP.

an older type in about 60 minutes. Slow periodic oscillations are due to the unsteadiness of the arc, while the quick changes in the curve are due to the regulation of the lamp.—*Elek. Zeit.*, Jan. 16.

Direct-current Arc Between Metallic Electrodes.—A. GRAU AND F. RUSS.—Guye and Zebrikoff have recently published measurements on the potential difference of a direct-current arc between metallic electrodes as function of current and arc length. Their results show that Mrs. Ayrton's formula for carbon arcs is also applicable to arcs between metallic electrodes, but the arc lamps used by these authors were not more than 4 mm. The present authors have made experiments between cooled copper electrodes in which arcs ten times as long were employed and their results also show that Mrs. Ayrton's formula is applicable.—*Phys. Zeit.*, Feb. 1.

Power.

Swedish Power Station.—Some notes on the way in which the demands in connection with the important electric power station at Trollhätten have grown. During 1906 the Swedish Congress voted a sum of 750,000 kr. (1 crown about = 25 cents) toward it; a specified plan was brought forward toward the end of 1906, and the Congress this year voted further 7,750,000 kr. toward the installation, and now a further sum of 2,800,000 kr. is asked for. The fact is that the 28,500 horse-power upon which the first plan was based, and which, by somewhat heavily taxing the turbines, could be raised to about 34,000 horse-power, will not even suffice for the requirements at the end of the year 1908, when it is expected that the power station will be ready to be taken into use. This will more especially be the case should the State railways, of which there appears to be some likelihood, at that time require power from the station for the electrification of the Gothenburg-Lund section. Under these circumstances, the board thinks it advisable that the question of exploiting the falls to the full extent of their capacity should be placed before the forthcoming Congress, so that no unnecessary or avoidable delay may be caused. The board would prefer that the whole sum of 11,300,000 kr. be voted, so that the station could be at once built for its full capacity of 76,000 electric horse-power. The board has entered upon a preliminary agreement with the city of Gothenburg, which may soon be made final, and which necessitates the construction of lines to Gothenburg and the building of a transformer station there; the demand there may, it is thought, easily reach or surpass 7000 kilowatts. Negotiations are pending with several other towns, including Sköfde, Talköping, Vara and Grästorp, which when completed would likewise necessitate the construction of lines and transformer stations. The State, it is urged, ought to install distribution lines, which it can do more cheaply and quickly than others, and it is considered that the direct profits and the indirect advantages would soon outweigh the risk.—Lond. *Eng'ing*, Jan. 10.

Refuse Destructor and Electricity Works.—An illustrated description of the Fulham station in London, which is one of the most successful existing combinations of a generating station and refuse destructor under municipal control. The original plant erected in 1901 consisted of three 300-kw, two-phase alternators driven by slow-speed steam engines. The extensions installed later show the transition stages from the low-speed to the high-speed reciprocating engine and thence to the steam turbine. The turbine installed is of the vertical Curtis type and drives a 750-kw alternator at 1500 r. p. m. The set has considerable overload capacity and has given as much as 1250 kilowatts for two hours. The destructor is of the Horsfall type and consists of 12 destructor cells of the usual top-feed type with a grade area of "30 feet" each. During the year ended March 31, 1907, the generating works costs of the electricity department averaged 1.6 cents per kw-hour, giving with management and other charges 2.246 cents and with the inclusion of all capital charges 4.516 cents per kilowatt-hour sold. The total kw-hours sold amounted to 2,523,417, and the maximum demand was 1502 kilowatts with a lamp connection of 110,723. There is a power load at Fulham represented by 1167 horse-power of motors. Fulham was the first London district where the price is 2 cents per kw-hour for power was introduced, and now the average price received per kw-hour is, with one exception, the lowest in London.—Lond. *Elec. Eng'ing*, Jan. 23.

Cost of Power.—I. V. ROBINSON.—A paper read before the Inst. of Eng. and Shipbuilders in Scotland. The author compares the estimated cost of power supply at a high load factor such as is obtained under the conditions of electrochemical work from a water-power plant and from a gas-driven plant. A number of figures are given and from his comparison it appears that the power generated from blast-furnace gases costs about the same as water-power, when the capital cost of the generating station, with or without transmission lines as may be required, is about $90 per horse-power delivered at the consumers' boundary. Investigation shows, however, that the majority of water-power plants are estimated to cost more than this figure.—Lond. *Elec. Eng'ing*, Jan. 23.

Geneva.—R. WEBER.—The city of Geneva in Switzerland has already two important hydro-electric stations, which, however, now are no longer sufficient, so that a third water-power station is to be erected utilizing a fall on the Rhone River. The project of the hydraulic development is described and illustrated. —*La Lumière Elec.*, Jan. 25.

Buildings for Power Houses.—H. BOOT.—A paper read before the (London) Society of Architects on the design of buildings for power houses, in which the general requirements to which attention should be paid by architects when designing generating station buildings are dealt with.—Lond. *Elec. Eng'ing*, Jan. 23.

Electric Power in Iron Works.—An illustrated description of the electric equipment of a British iron works in which electric motive power is now used throughout, while formerly steam and gas engines were employed. A considerable amount of power is employed for electric welding.—Lond. *Elec. Eng'ing*, Jan. 23.

Gas Engines.—F. W. BURSTALL.—His long third report to the gas-engine research committee of the (British) Institution of Mechanical Engineers with an account of the discussion which followed.—Lond. *Eng'ing*, Jan. 24.

Traction.

Single-phase Traction Motors.—M. OSNOS.—A paper read before the German Association of Elec. Engineers on single-phase commutator motors, with special reference to traction. Tests were made with two 110-hp motors which could be used with either of the six following arrangements: (1) as series motor with a compensation winding connected in series; (2) as series motor with short-circuited compensation winding; (3) as reverse repulsion motor; (4) as ordinary repulsion motor or Atkinson repulsion motor; (5) as compensated series motor; (6) as "double fed motor." As double fed are such single-phase commutator-motors designated in which the axles of the stator and in which the axles of the stator field and rotor field form an angle between 0 and 90 degs. with each other and in which a voltage is impressed on the stator as well as on the rotor. A general equation is given for the volt-amperes consumed per meter-kilogram of starting torque, and it is proven that for all six arrangements the consumption of volt-amperes per meter-kilogram of starting torque is a minimum if the volt-amperes consumed for excitation equal the volt-amperes consumed for the stray flux. With respect to the smallest consumption of volt-amperes per meter-kilogram of starting torque all the above

six arrangements with the exception of (4) (ordinary repulsion motor) are practically equivalent. When running, the motors of the arrangements 1 to 3 are about equivalent with respect to the power factor, arrangement 4 is inferior, while arrangements 5 and 6 are about equivalent and both superior to the arrangements 1 to 3. Results of tests are given which confirm the theoretical results and prove that the overload capacity of the arrangement 6 is about 40 per cent greater than that of the compensated series motor (arrangement 5). On mountain roads it is at times advantageous to be able to let series motors or motors with series characteristics run with constant speed. If the difference in level is not very great a uniform and good operation is thus obtained, for the reason that for a single predetermined constant speed sparkless running and a high-power factor and efficiency can be obtained more easily than for varying speed. On the other hand, if the difference in level is great, it is advantageous to run up hill with a series arrangement with varying speed and down hill with constant speed, the motors then returning energy to the net work. In tests of an experimental car on the mountain road from Homburg to Saalburg it was found that when running down hill it was possible to recuperate continuously about 40 kilowatts. When running up hill 12.87 kilowatt-hours were consumed; when running down hill over the same distance 6.97 kilowatt-hours were returned from the motors into the net work, so that the number of kilowatt-hours consumed on the round trip was only 5.90 kilowatt-hours. The energy recuperated when running down hill amounted to about 55 per cent of the energy spent in running up hill.—*Elek. Zeit.*, Jan. 2, 9 and 16.

Watertown.—A. H. Lefevre.—An illustrated article on the equipment of the Black River Traction Company, of Watertown, N. Y. It is probably the only water-power station in the country generating current for a railway without attendance and giving uniform voltage without a governor or any regulating device. This is accomplished by providing each generator with a very strong series field and comparatively weak shunt field. When the turbine is running at its maximum speed of 200 r. p. m. with full gate and no load, the generator, working on shunt field alone, has a voltage of 550. As the load goes on, the speed, and consequently the current in the shunt coils, drops off, but the current in the series coil increases, and the winding of the series coil is so proportioned that the total flux increases with the load, that is, inversely with the speed. In this way the decrease in speed of the armature is compensated for by an increase in the strength of the series field and a practically constant voltage is assured. Another special feature is the use of a vacuum system of ventilation in the cars.—*St. R'y Jour.*, Feb. 8.

Installations, Systems and Appliances.

British Central-Station Statistics.—The annual statistics of British central stations supplying current for light and power but without a tramway load. A vast amount of information on history and equipment of 273 different stations is given in 36 different columns. The number of stations dealt with is practically the same as last year. A point of considerable importance is the great increase shown in the horse-power of the motor connections, indicating that supply engineers and public alike are paying much attention to this branch of electricity supply. Examples are the Glasgow undertaking, where an increase from 11,954 horse-power to 19,805 horse-power is shown, and Coventry, where the increase is from 2346 horse-power to 3881 horse-power. The London undertakings of this class, while showing in most cases increases of a few hundred horse-power in the motors connected, cannot point to any developments such as those indicated above. It would appear that metallic-filament lamps are being adopted to a considerable extent for street-lighting purposes, and this is more likely to become general if it is found that such lamps can without difficulty be burned in series. The majority of the undertakings are now paying considerably more per ton for their coal supply than was the case a year ago, but fortunately the improved load factors due to the additional motor loads should prevent any material increase in the cost per unit.—Supplement to Lond. *Elec.*, Jan. 17.

Small Gas-electric Station in Germany.—The first part of an illustrated description of the electric plant of Steudal in Germany, a city of 25,000 inhabitants, which had already a municipal gas plant. The municipal electric station was installed to cooperate with the gas plant. Illuminating gas from the gas plant is used in gas engines, but as a reserve a small suction-gas plant is being installed. The gas engines can be operated either with illuminating gas or with suction-producer gas. They have a capacity of 80 and 160 horse-power respectively. The dynamos coupled to the gas engines have capacities of 60 to 115 kilowatts respectively and supply a three-wire system at 2 by 220 volts.—*Elek. Anz.*, Jan. 5.

German Station.—O. Ely.—The first part of an illustrated description of the municipal central station of Coburg, a small town in middle Germany. Electric energy is used for light, power and traction. The price per kw-hour is 15 cents for lighting and 6.25 cents for power. Two Dowson gas producers, each of 200 horse-power, supply producer gas to three gas engines coupled with shunt-wound, direct-current dynamos, two of which have a capacity each of 67 kilowatts and the third 100 kilowatts.—*Elek. Zeit.*, Jan. 23.

Wires, Wiring and Conduits.

Enclosed Fuses.—W. Fellenberg.—A long illustrated paper read before the Dresden Electrical Society on a new form of enclosed high-tension fuses made by the Allgem. Elek. Ges. In central stations of a large capacity of 2000 or 3000 kilowatts or more, automatic circuit-breakers are preferable for the protection of all machines. But in smaller stations as well as in the net works of larger stations this new type of enclosed fuses is thought to be useful, especially since they need no attendance. They may also be used in series with automatic circuit-breakers to increase the protection. The fuse wire is best arranged in zig-zag or loop form. Copper is preferable to silver. The shell is made of porcelain. The fuses are made in standard sizes of 110 mm length and may be combined for any desired voltage.—*Elek. Zeit.*, Jan. 16 and 23.

Electrophysics and Magnetism.

Magnetism and Specific Heat.—P. Weiss.—A paper in which the author shows that the discontinuities observed in the magnetization of iron, nickel and magnetite at certain high temperatures are exactly paralleled by similar discontinuities in the specific heat, and gives a qualitative and quantitative explanation of this fact.—*Comptes Rendus,* Dec. 30; Lond. *Elec. Eng'ing,* Jan. 23.

Units, Measurements and Instruments.

Determining the Power Factor.—C. Herz.—The phase difference ϕ ———— between current and potential difference can be easily found for a three-phase system by means of the formula

$$tang\ \phi = \sqrt{3}\frac{W_1 - W_2}{W_1 + W_2}$$

where W_1 and W_2 are the readings of two wattmeters connected in the well-known way. By putting the ratio of W_2 to $W_1 = x$ (smaller than unity) the formula becomes

$$tang\ \phi = \frac{\sqrt{3} - x\sqrt{3}}{1 + x};$$

x may be found directly from the readings of the two wattmeters by means of a slide rule, while the angle of phase difference ϕ is found by a simple graphical method indicated in Fig. 4. If $OP = 1$ and $OQ = \sqrt{3}$, then the equation of the straight line PQ is $y = \sqrt{3} - x\sqrt{3}$. Then QR is also made equal to unity and OH equal to x (found from the two wattmeters), and if $H\ M$ is perpendicular on OP then the angle $M\ R\ P$ is the desired angle of phase difference. A slight modification of the method for practical purposes is also described.—*La Lumière Elec.*, Jan. 25.

Measurement of Radiant Energy.—W. W. Coblentz.—An article in which the author describes the instruments and methods used in radiometry. He discusses in detail four in-

struments for measuring radiant energy, viz., the radiomicrometer, the linear thermopile, the radiometer and the bolometer with its auxiliary galvanometer. The radiomicrometer is capable of great improvement, by reducing its weight, by lengthening its period and by placing it in a vacuum. On account of para- and diamagnetism the sensitiveness of the radiomicrometer is very limited, perhaps only a fifth of the best bolometers. The Rubens thermopile is as sensitive as the best bolometer, and its heat capacity can be greatly reduced by using thinner (0.06 to 0.08 mm diameter) wires, which are made shorter, thus keeping the resistance low. The thermopile is not so well adapted as is the bolometer for instantaneous registration of radiant energy and it does not admit so great a range in variation of sensibility, but on account of its greater steadiness it commends itself for measuring very weak sources of radiation, e. g., the extreme ultra-violet and infra-red region of the

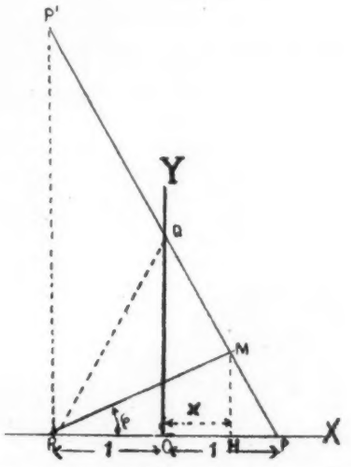


FIG. 4.—DETERMINING THE POWER FACTOR.

spectrum. The radiometer can be made just as sensitive as the bolometer, but its period will be much longer. This long period is of minor importance so long as we are dealing with a constant source of radiation. A bolometer installation is so distributed that it is difficult to shield from temperature changes. Nevertheless, despite its defects, it is the quickest acting of the four instruments considered and is the best adapted for registering the energy radiated from a rapidly changing source. For precision work it is necessary to keep the bolometer balanced to less than 1 cm deflection. The auxiliary galvanometer is the main source of weakness in measuring radiant energy, and in places subject to great magnetic perturbations a period greater than 5 seconds, single swing, is to be avoided. In measuring intense and weak sources of radiation the thermopile and the bolometer have the same relative accuracy and there is little preference between the two.—*Bull. Bureau of Standards,* Jan. (Vol. IV, No. 3).

Electric Thermometer for Measuring Gas Engine Temperatures.—H. L. CALLENDAR AND W. E. DALBY.—A (London) Royal Society paper describing a form of platinum thermometer which measures directly the temperature of the gas in the cylinder of a gas-engine at some one point of the cycle. In order to avoid uncertain corrections, it is necessary in any attempt on this problem to employ wires fine enough to follow the changes of temperature of the gas very closely during suction and compression. If such a wire be employed under working conditions, it must be perfectly screened from the flame during explosion. The arrangement designed by the authors is such as to introduce the thermometer into, and withdraw it from, the cylinder at the proper instants, and to do this without making any change in the usual form and extent of the clearance surface during the time interval comprising the end of compression. The thermometer itself consisted of a loop of platinum wire, 0.001 in. diameter and 1 in. long, and a compensation loop of similar wire was provided to eliminate the end effects arising from conduction to the leads. The current employed in measuring the change of resistance (which was about 1 ohm for 100 deg. C. rise) was about 1/200 ampere. This thermometric arrangement was contained in a small valve inserted through the spindle of the admission valve, which was bored out to receive it. This thermometer valve was introduced into the cylinder by a cam operated by a simple gear. In order to measure the temperature at a definite point of the cycle, a periodic contact-maker was inserted in the testing battery circuit. At first an ordinary wiping contact was employed, but, owing to certain disadvantages, a novel form of periodic contact was designed and made. This consisted of two cams on the same axle and two brushes. The shape of each cam was a flat spiral, which lifted the corresponding springy brush away from the axis as the shaft rotated, and the spirals each terminated with a stop which allowed the brushes to fall suddenly. The steps were staggered in angle so that the brushes fell at different instants. Now one side of the electrical contact was carried by one brush, and the other side of the contact by a projection on the second brush; and thus, by setting the cams initially at the proper angle, any desired period of contact could be brought about at any desired point of the gas-engine cycle.—London *Royal Soc. Procs.,* Dec.; Lond. *Elec. Eng'ing,* Jan. 6.

Testing Meters.—E. KRAUS.—A paper read before the Association of Austrian and Hungarian electricity works. According to the Austrian law of 1894, electricity meters must be used in all installations and according to a later law, meters must be recalibrated every five years. It is now intended to make the recalibration somewhat easier for the stations so as to permit them to install calibration bureaus themselves. The present paper contains a description of several new apparatus of the Siemens-Halske Company which have been devised for such purposes and have been gradually modified in the course of years to meet the requirements of practice. The paper is fully illustrated.—*Elek. u. Masch.,* Jan. 26.

Self-Inductance.—L. COHEN.—A mathematical paper in which the author develops a formula for the self-inductance of a solenoid of any number of layers and which will give results accurate to within one-half of 1 per cent even for a short solenoid, where the length is only twice the diameter, the accuracy increasing as the length increases. The author also shows that Maxwell's familiar formula may lead in some cases to considerable errors.—*Bull. Bureau of Standards,* Jan. (Vol. IV, No. 3).

Fault Locating.—T. VAILLANT.—A brief article describing in detail how a short circuit between two phases of a three-phase cable was located, giving the measurements made together with the formulas.—*Elek. Anz.,* Jan. 2.

Telegraphy, Telephony and Signals.

Telegraphy and Telephony.—Summary of advances and improvements made in telegraphy and telephony in the last three months of 1907.—*Elek. Anz.,* Jan. 2 and 12.

Miscellaneous.

German Manufacturing Works.—An illustrated description of the Felton & Guilleaume-Lahmeyerwerke in Frankfort. The original founder of this company, Mr. Lahmeyer, died in December, 1907.—Lond. *Eng'ing,* Jan. 24.

German Electrical Imports and Exports.—Tables showing the imports and exports of different kinds of electrical machinery and apparatus to different countries during the month of November, 1907.—*Elek. Anz.,* Jan. 12.

BOOK REVIEWS.

LA IONIZZAZIONE E LA CONVEZIONE ELETTRICA NEI GAS. By Lavoro Amaduzzi. Bologna: Nicola Zanichelli. 368 pages; 88 illustrations. Price, 5 lire.

There are many books devoted to the subject of ionization. Some deal with the subject almost entirely from the standpoint of the mathematician. Others deal with it almost entirely from the standpoint of the descriptive physicist. Consequently, the quantitative facts are ordinarily either presented in difficult and indigestible form, or they are so meagerly presented as hardly

to be presented at all. This book is one of the welcome few which occupies a middle ground. It is sufficiently descriptive from the physical standpoint to be interesting reading, and it is also sufficiently mathematical to present the quantitative facts in a manner readily capable of assimilation. For example, the Lorenz theory of the Zeeman effect is usually either inaccessible or inassimilable to most students of technology. It is here developed in a clear and simple manner. The book will be welcomed by technological students interested in the large and rapidly growing subject of ionization.

Deutsches Patentrecht fur Chemiker. By Dr. Julius Ephraim. Halle: Wilhelm Knapp. 608 pages. Price, 18 marks.

Dr. Ephraim, who is a chemist and a patent attorney, gives here a treatise of colossal proportions and immense usefulness. His preface says: "This is the first exposition of patent law with sole reference to a certain technical field. In previous treatises, by eminent jurists, the general patent law was unfolded, but application of the same to concrete technical cases omitted. The present work, the first compilation of German patent law by a patent attorney, takes up the general principles of patent law, but arranges them in the order most applicable to chemical purposes, and for every principle explained gives a typical illustration from chemical technology fitted to elucidate the teaching of the patent law and also to set forth the application of the principle in practice." The result is a work of immense labor and of great usefulness. One can hardly imagine that an electrochemical inventor in Germany could afford to be without the work, its information would be so indispensable to him.

The idea of such a work is first-class, and most commendable. It is fervently to be hoped that similar treatises, based on this as a pattern, may appear in English, giving us in a complete and accessible manner "U. S. Patent Law for Chemists and Electrochemists," "U. S. Patent Law for Electrical Engineers," etc.

Technical Dictionary in Six Languages. Vol. II. *Electrical Engineering.* By Chas. Kinzbrunner: Edited by K. Dienhardt and A. Schlomann. New York: McGraw Publishing Company. 2100 pages; 4000 illustrations. Price, $7 net.

The second volume of this work follows the same excellent arrangement used with the first volume (Machine Elements and Tools), namely, a diagram or sectional illustration showing the thing described, together with a descriptive word or phrase in each of the six languages, English, German, French, Russian, Italian and Spanish. An immense amount of labor has evidently been expended in insuring the completeness of the dictionary and the accuracy of the information contained therein. An indication of the completeness may be obtained from the fact that 1360 pages of the book are devoted to the strictly dictionary feature, each page dealing with about ten different subjects—a feature not found in the usual dictionary is an alphabetically arranged table of contents covering the Russian words and phrases, and a separate table of contents covering the words in all of the other languages. The accuracy of the descriptive matter is attributable to the co-operation of a large staff of contributors to the text and revisers of prominence in the electrical profession in the countries where the six languages are used. The production of such a dictionary is by far a more stupendous task than has ever previously been accomplished by any one man or collection of men, hence the book is in a class by itself. The present volume covers the whole field of electrical engineering, including telegraphy and telephony, except electric traction. It is stated that the latter subject will be dealt with fully in a volume on "Railway Engineering," which is in course of preparation. In the present volume the errors of translation and the important omissions so prominent in the dictionaries heretofore obtainable for use in translating a technical article from one language to another, have been largely eliminated, so that the book can be employed with confidence by anyone engaged in such translation.

Air Break Circuit-Breakers.

In a paper entitled "Air-Break Circuit-Breakers and Their Applications," read before the Electric Club, of Cleveland, Ohio, Mr. C. C. Badeau, after tracing the development of the circuit-breaker and describing its various forms and makes, gave some interesting data on the circuit-breakers made by the Switchboard Equipment Company, of Bethlehem, Pa., of which company he is the chief engineer. A number of these circuit-breakers are illustrated herewith. It will be noticed that the laminated brush is made stationary and that the flexible strip in back serves not only as the rear contact, but as the magnetic coil as well. On small circuit-breakers the contact studs are screwed directly into the brush and the coil, as shown in Fig. 2, but in larger breakers, in order to save joints, this brush and coil are brought directly through the board, as shown in Fig. 3. This circuit-breaker is made in sizes rated at from 5 to 10,000 amperes.

There are two things that all circuit-breakers should do: in the first place, they should carry their full rated load without overheating and, in the second place, they should open on overload without undue injury to the contacts. The author deplores the custom among some consulting engineers of specifying generators and motors on the temperature basis and auxiliary apparatus on the basis of amperes per square inch without reference to the temperature rise. That this method of rating

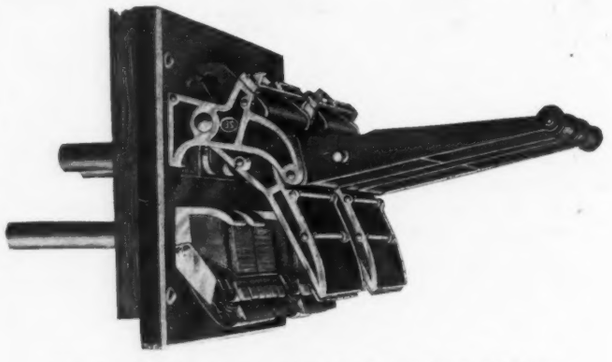


FIG. 1.—10,000 AMPERE, DOUBLE-POLE CIRCUIT-BREAKER.

will give varying temperature rises according to the size of apparatus was shown in a curve giving the temperature rises at varying amperes per square inch on bright copper studs of various diameters suspended in still air. This is due to the fact that the ultimate temperature of any piece of electrical apparatus is determined by its resistance and its radiating surface. The Switchboard Equipment Company has appreciated this fact and has not rated its circuit-breakers on the arbitrary, amperes-per-square-inch basis, but has taken the temperature rise as the limiting feature, and the design curve of these breakers takes the form of a straight line on logarithmic cross-section paper. The curve is based on the carrying capacity of round copper studs, and all of the various areas and contact surfaces of the company's breakers are ratios of this carrying capacity. Circuit-breakers designed by this curve have been built in sizes rated at from 10 to 10,000 amperes with a remarkably close adherence to the calculated results, the resulting temperature rise, at full-load, always being less than that indicated by the curve. This is the first attempt, as far as the author knows, to lay out a design curve for any auxiliary apparatus which has as many joints as a circuit-breaker or switch, and the success of the curve is probably due in part to the fact that the copper in the circuit-breaker is so disposed as to give a maximum radiating surface for its area and the factor of safety introduced by this has more than compensated for the inevitable uncertainty introduced by contact resistances.

In order successfully to open the circuit, breakers should be provided with low-resistance secondary contacts which will protect the main contact surface from the burning necessarily caused by the arc and should open the circuit quickly and

securely, and with a sufficiently long break to enable the arc to rise. It is also necessary that the circuit-breaker be so constructed as to afford protection to the circuit under any and all conditions of said circuit. For example, assume that a motor is grounded on one side of the circuit-breaker, and the line is grounded on the other side of the circuit-breaker. This produces two paths for the electricity on the grounded side, one path through the circuit-breaker and one path through the grounded side, and if this grounded side happens to be the side in which is connected the coil of a single-coil, double-pole circuit-breaker, it will render this coil inaccurate by the amount of current flowing through the ground. In a double-pole, double-coil circuit-breaker there will always be at least one side of a circuit-breaker which is not grounded.

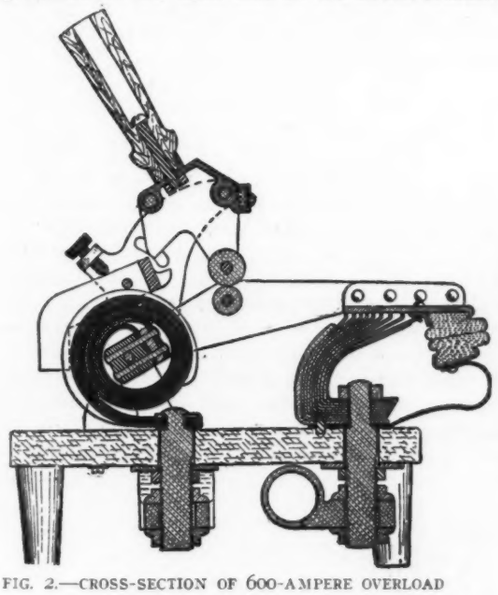


FIG. 2.—CROSS-SECTION OF 600-AMPERE OVERLOAD CIRCUIT-BREAKER.

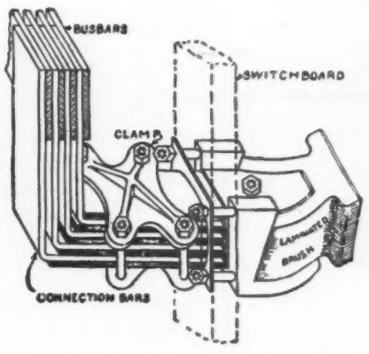


FIG. 3.—BRUSH FOR 300-AMPERE CIRCUIT-BREAKER.

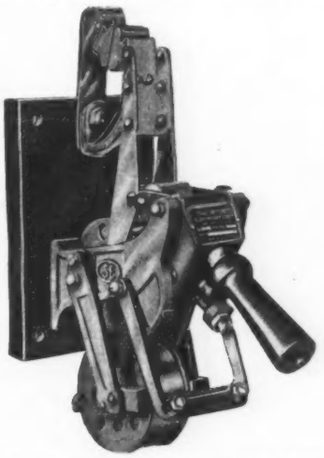


FIG. 4.—100-AMPERE OVERLOAD SHUNT-STRIP CIRCUIT-BREAKER.

Circuit-breakers are divided into several different types according to their applications. Figs. 1 and 2 show overload circuit-breakers which operate when the current flowing through the heavy series coil reaches a predetermined maximum. The second type, shown in Fig. 4, has a shunt trip attachment. That is, it is provided with a fine wire coil, and when its circuit is closed by means of a push button or other apparatus this coil is energized and the circuit-breaker is opened. This type of breaker is used wherever it is desired to open a circuit from a distant point, and has found its principal application on printing presses, cranes, etc. It is used on cranes to prevent the block from coming in contact with the body of the hoist. When so used, the block is provided with a small contact which closes the circuit when it comes in close proximity to the body of the crane and trips the circuit-breaker.

The type shown in Fig. 5 has a no-voltage release, and is one in which the circuit is opened when the current is removed from a fine wire coil instead of when a fine wire coil is energized. This type of breaker is used principally in the protection of motors, as the no-voltage attachment on the breaker is sure to open if for any reason the circuit is interrupted and prevents the sudden rush of current due to the throwing of full-voltage on the armature of a motor at rest.

Fig. 6 shows an underload circuit-breaker which operates when the current has reached a predetermined minimum value. The armature of this breaker normally tends to fall and is restrained by the pull created by the series coil. When the current has fallen to a predetermined point, the weight falls and trips the breaker. It will be noticed that the handle is fastened to an auxiliary piece pivoted to the handle lever. This pivoted piece has an extension bearing against the armature. In closing the breaker this projection pushes the armature against the core pin, while the armature is free to drop a considerable distance before tripping the breaker. This device renders the breaker sure and positive in its action. This type of breaker is used for the protection of storage batteries. When batteries are fully charged their voltage approaches that of the generator, and the passage of current is small. The breaker is so set that it will open when this current is diminished to one-tenth of normal current.

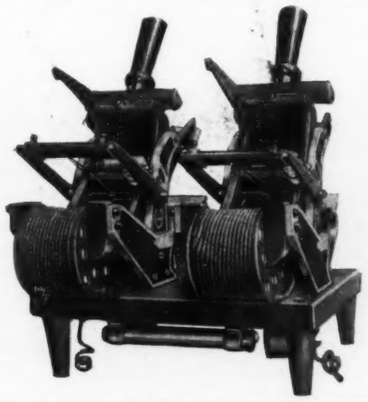


FIG. 5.—300-AMPERE DOUBLE-POLE, OVERLOAD AND NO-VOLTAGE CIRCUIT-BREAKER.

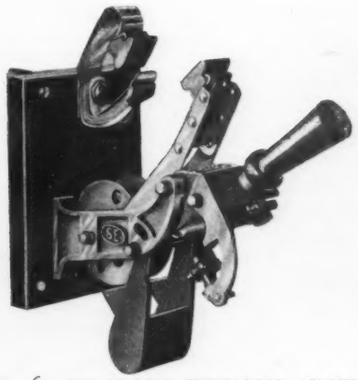


FIG. 6.—100-AMPERE UNDERLOAD CIRCUIT-BREAKER.

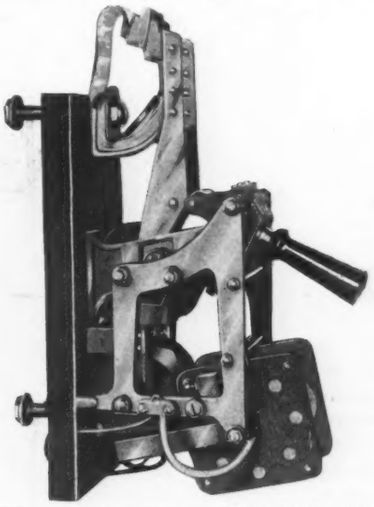


FIG. 7.—700-AMPERE SINGLE-POLE OVERLOAD AND REVERSE-CURRENT CIRCUIT-BREAKER.

Fig. 7 shows an overload, reverse-current circuit-breaker which operates on an overload, or when the direction of the flow of the current has reversed. In this type of circuit-breaker there is a core which is energized by means of a series coil, the

polarity of this core depending on the direction of the flow of current through the series coil. There is also a moving U-shaped armature co-operating with this core, the polarity of this moving U-shaped armature being fixed by means of a potential coil. Inasmuch as the polarity of the current is not reversed when the direction of the current flow is reversed, the potential coil will maintain a constant polarity on the U-shaped portion of the magnetic circuit. When the current is flowing in normal direction, the polarities of the two parts of the magnetic circuit are so fixed that they will oppose each other. When the polarity of one, therefore, is reversed due to the reversal of the flow of energy through the circuit, the two parts of the magnetic circuit will attract each other and cause a movement of the U-shaped portion, which will trip the circuit-breaker.

It will be noticed that if for any reason the potential coil is de-energized, due to failure of potential on the circuit caused by destruction of the coil by lightning or the accidental breaking of any of the connections, the series coil will immediately move the U-shaped portion which completes the magnetic circuit and will trip the circuit-breaker in such an event. The parts are so proportioned that this will happen when from 50 per cent to 75 per cent of full-load current is passing through the circuit-breaker.

Storage Ignition Battery.

The Helios Manufacturing Company, Bridesburg, Philadelphia, Pa., has placed upon the market a type of storage ignition battery which is claimed to possess many advantageous features. The containing case is of very heavy hard rubber, divided by hard rubber partitions into two or three compartments so as to contain either two or three separate elements. Each compartment is provided with a cover, which is sealed into place, and over these individual covers is placed a heavy hard-rubber master cover, which effectually conceals all of the live parts, and entirely prevents the slopping of acid, even under severe service.

STORAGE IGNITION BATTERY.

On the bottom of the containing jars are strips of soft rubber, and a soft-rubber band passes entirely around the lower portion of the case so that shocks from severe road service are absorbed sufficiently to prevent the jars from being broken.

The handle by which the complete battery can be carried is of rubber webbing, and there is absolutely no metal exposed to become corroded, nor is there any wooden case to become saturated with acid, thereby not only destroying its appearance, but causing a leakage of the current from one cell to another. There is no brass used at any point in this battery, nor is there anything that can be deteriorated or acted upon by either acid or fumes. It is stated that the construction of the battery is so simple that in case of damage or deterioration of the elements, they can be replaced by a novice, and all the parts are interchangeable so that repairs can be furnished at any time, if needed.

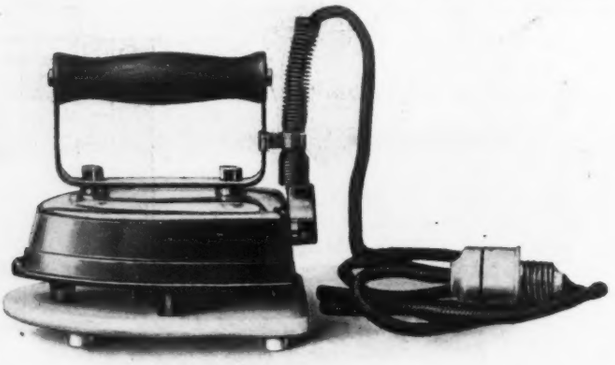
Electric Equipment of a Copper Concentrator.

Sixteen miles east from Salt Lake City there has recently been completed a concentrator plant from which more than 150,000 lb. of copper will be obtained per day. For the operation of the mill there has been installed a 7000-hp station containing three-phase generators driven by reciprocating engines. The generators are wound for 4000 volts; the e. m. f. is transformed to 440 volts for driving induction motors in the mill, and to 40,000 volts for the transmission of energy over a 15-mile line to a small mill at Bingham canon. J. G. White & Company acted as consulting engineers for the plant. The Gates gyratory breakers and mill machinery, and two 1500-hp Reynolds-Corliss engines were built by the Allis-Chalmers Company.

Electrically Heated Sad-Iron.

The electrically heated sad-iron shown in the accompanying illustration is now placed on the market by the Westinghouse Electric & Manufacturing Company. In form the iron differs only from an ordinary utensil in its more symmetrical and attractive appearance, and in being provided with terminals and a flexible cord through which the current is transmitted. Its heating mechanism, which is entirely concealed, keeps the iron at the proper temperature at a minimum consumption of current. It consists of a flat insulated resistance strip clamped by hydraulic pressure between two flat iron plates, forming a solid heating element of high thermal conductivity, and having a large heat-storage capacity.

The design of the element is such that the heat is evenly distributed over the entire bottom of the iron, the edges and point being practically the same temperature as the middle of the bottom. A non-conducting element is used between the top of the iron and the heating unit. This construction results in the top of the iron being cooler than its face. The heating unit is hermetically sealed in its insulation and cannot, therefore, deteriorate any faster than the iron, as it is not subject to the oxidizing effects caused by contact with air.



ELECTRIC SAD-IRON.

The iron is extremely simple and with nothing to get out of order or to require renewal. Irons which have been in use continually for the past six years, without costing a cent for repairs, are in as good condition to-day as ever. In fact, the

electrical construction is so simple and durable that there is no reason why it should not last as long as the iron itself.

The terminals are protected by a solid metal guard, and the cord leading from them is securely anchored by a clamp on the handle of the iron. A wire spring which surrounds the cord at this point prevents any sharp bends. A separable plug is provided by which the iron can be connected to any convenient lamp socket without twisting. A small spring attached to the cord takes up all slack, and so keeps it from dragging on the clothes or getting in the way of the operator.

The polishing surface of the iron is of highly polished cast-iron, found by experience to be the most satisfactory surface for the purpose. The upper portions of the iron have a burnished nickel-plate surface. The handle is of ebonized wood, heat-proof and unbreakable. A heat-proof stand, upon which the iron should be set when not in use, is provided with every iron. The irons are made to suit all commercial lighting circuits, and can be used on either alternating or direct current with equally satisfactory results.

Motor-Starting Enclosed Rheostats.

The Ward Leonard Electric Company, Bronxville, N. Y., has placed on the market a line of motor-starting rheostats having both the resistance portion and the face plate entirely enclosed;

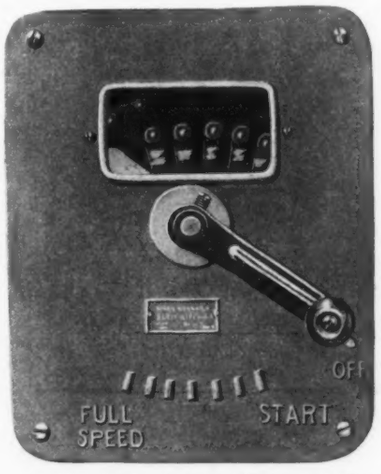


FIG. 1.—FACE OF MOTOR-STARTING RHEOSTAT.

that is to say, all current-carrying parts are enclosed by casings.

In dusty, dirty places previous practice has been to place the motor-starting rheostat inside of a slate box in order that ac-

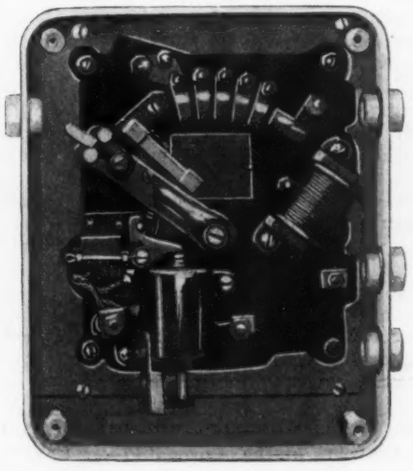


FIG. 2.—VIEW OF MECHANISM.

cumulated dampness or dirt could not affect the parts, thereby causing a short-circuit and presenting a fire hazard. In practice it is found that the door of these enclosing cabinets is usually left partly or entirely open; an accumulation of dirt occurs with its consequent damage. This new line of rheostats possesses the advantage that the enclosing case is always closed. As designed, the controlling lever does not carry current. The lead wires enter through bushings, and a plate of glass is set in the case enclosing the face-plate so that the operator can readily see the contacts. All of the Ward Leonard protective features are embodied in these new rheostats.

Electrical Machinery for Gold Assaying.

The Charles J. Bogue Electric Company is shipping to the government mint at San Francisco an electrical machine to be used in determination work in a new chloride-of-gold process. The equipment consists of a motor-generator set with a 2½-hp 30-volt motor and a 200-ampere, 6-volt generator, regulated from one-half to six volts. One of the first of these machines was set up in the mint at Philadelphia about two years ago and has a 1500-ampere, 15-volt generator. During the test, which takes from 10 to 14 days, the motor runs continuously.

Circuit Fittings for Emergency Work.

James S. Stewart, chief electrician of the Madison Square Garden, has designed a line of receptacles, rosettes, sockets, etc., particularly adapted for emergency lighting circuits. Before he became connected with the Madison Square Garden, Mr. Stewart was chief electrician of the Metropolitan Opera House. At the Garden the various shows during the winter follow one another in close succession, with sometimes less than 24 hours intervening, and as often the whole scheme of lighting is entirely changed to meet the requirements of the coming show, the electricians are compelled to work under the highest pressure. Mr. Stewart's inventions contain many time- and labor-saving points, and will be of great value in places like the Garden, where rapid work is necessary. The Atlantic Electric Goods Company will put the line on the market in about two months.

Large Storage-Battery Equipment.

The Electric Storage Battery Company, of Philadelphia, has recently installed in the Edgar Thomson Works, of the Carnegie Steel Company, a storage battery consisting of 125 elements, and having a capacity of 10,000 amperes, with switchboard and two regulating boosters, one of which is a spare unit. This will be used in regulating load fluctuations and can be discharged at a rate of 15,000 amperes in times of emergency.

The chief cause of the fluctuations of load necessitating a battery of such great capacity is the operation of two 750-hp 250-volt electric motors in one of the rail rolling mills. The current taken from these motors often varies from nothing to 15,000 amperes within a period of a few seconds, the result being not only to cause heavy strains on the generating apparatus, but to increase the number of generators necessary over those that would be required were it not for these excessive fluctuations. Although the battery is located near the rail mill, the booster regulating the coil is located between the generator bus and the feeder panels, so that smaller fluctuations of load due to cranes, skip hoists, etc., are also handled by the battery and the load on the generator is kept practically constant. The improvement in the service can be realized by the fact that since the installation of the battery it has been found possible to cut off a 1000-kw generator from the system, which means that the plant is often operated with less than half the generating apparatus than was found necessary before the battery was installed. It also provides the steel company with a generator which can be used as a reserve or to meet the rapidly growing demand on the power station. The above battery has a greater current output than any other individual battery installation in the world. It is the tenth largest battery contracted for by the Electric Storage Battery Company for this class of service.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies are to the effect that buying of spring goods was more active last week, but was dominated by caution and conservatism. In no case, however, was the buying reported equal to that a year ago and in some instances the decreases were very heavy. Reports as to the various industries were conflicting, more business being done in some instances, with numerous resumptions of full time noted. Some finished iron and steel mills resumed, but others were reported slowing down, and the improvement as a whole was slight. Railway earnings continue to decrease and leading railway systems report one-third of their cars idle. Collections are still backward, being especially slow at the south, where much cotton is being held. Business and collections are, however, reported better in the Pacific Northwest. Prices of commodities are lower, especially at the exchanges dealing in farm staples. Wheat fell to the lowest price of the season on smaller export inquiries and statements of large shipments from Argentina. Railway earnings for the first week of February decreased 15.4 per cent as compared with the same period last year, and foreign commerce at the port of New York for the week showed a gain of $4,321,043 in exports and a loss of $6,370,677 in imports from the movement in 1907. Pig iron continues dull but the demand for steel bars was a little improved. New business in steel rails was light, and there was a fair demand for structural material, but prices were cut by independent interests. Wire, wire products and tin plate were the bright spots in the general situation. Operations have been resumed in part in some finishing plants, but the movement in this respect was very slow. *Bradstreet's* reports 326 business failures during the week ending Feb. 13 against 273 in the previous week and 204 in the corresponding week last year.

THE PANIC—RETROSPECT AND PROSPECT.—Commenting on the causes of the recent financial depression and carrying his line of reasoning farther back than most persons, Mr. Arthur Williams, general inspector of the New York Edison Company, believes that the panic was brought about by a series of events, world-wide in their influence and extending over a period of years and which finally compelled a universal readjustment of values. Mr. Williams, who is a close student of economic conditions, believes that under the present situation business stagnation cannot continue for any length of time. He says: "In this country it would be impossible for industrial stagnation to continue long. There is too little margin between the minimum of consumption and the maximum of production. On every hand appear unmistakable evidences of renewed activity in the business world. Building construction, the last to feel the force of the money stringency, will also probably be the last to recover from the effects of the recent crisis. Contracts are usually made well in advance of actual work and many months pass in their fulfilment—stagnation follows after the crisis has been reached and passed in many other industrial directions. While as yet there may be little improvement in building operations, manufacturies, especially of life's necessities, appear commencing to resume on a large scale. The causes for the recent depression lay in the head rather than the body of the nation. We now lack the fundamental causes found in similar periods of history, namely, over-production and short crops. To-day, according to the well informed, we seem to have practically no over-production, and crops were never more abundant. Over the basic conditions which finally resulted in the panic no human agency probable could have had complete control. Personally I am of the opinion that they were the result of an inevitable readjustment of monetary values brought about by a series of events, world-wide in their extent. As time passes much of the original cause of our recent troubles will doubtless be found in the readjustment of interest values. Where money is plentiful and the demand for it limited, interest rates go down; where the reverse is true, and money is hard to get, because of the many opportunities for its safe use, the price that people are willing to pay to use it—interest—goes up. All recall that just previous to 1898 in every direction interest was falling. Great corporations were floating their bonds on a 3½ per cent basis and many of the savings banks reduced the interest to their depositors to the same rate. If I recall rightly, predictions were freely offered that the time was not far distant when this country would be on a 3 per cent basis, and I believe that government bonds were actually sold on a basis of 2 per cent, but, here, other considerations also counted. This period was followed by the Spanish-American war with its accompanying cost, the awakening of many branches of industry in this country, the destruction of great property values and the opening up of the Philippines, Porto Rico and Cuba to the investor who, assured of comparative safety of various enterprises, found a much higher rate of interest for his money than any corresponding industries of this country were then prepared to offer. This was followed by the Boer war, again costing vast sums, attended by the destruction of millions of property and the opening up of new fields for English investments, again paying higher rates of interest. Even greater moment was the Russian-Japanese war, destroying the navy of one country, as well as much property, and costing millions daily. Japanese loans were floated in England and here on more than a 6 per cent basis, and Russia, also in the market for money, was compelled to outbid former rates of interest. The destruction of San Francisco by earthquake and lesser catastrophes have also made large demands for capital; likewise the great undertakings of the railroads, examples being found in the New York Central and the Pennsylvania, and the embarking upon new industries in every direction have added their part in increasing the demand for capital and the prices people are willing to pay for its use. It became necessary that investments in stocks and bonds, of even the highest order, should readjust themselves from a basis of 3, 4 and 5 per cent to, in many instances, more than that which they were previously returning upon their market values. Practically all business is conducted on credit. The supply of gold—the basis of all values—is comparatively limited, and credit based upon confidence takes its place and enables the conduct of the industries of the country on their present enormous scale. Take away this confidence, and chaos inevitably follows. It is now in process of being restored, and when fully restored, probably little in the way of industrial activity will be left to be desired. There is little cause to fear that the time of complete restoration is far removed. There are no serious political issues at stake. We are to be congratulated upon the character of the men prominent in the public life of our country—the best in men is coming to the surface, moral standards are higher than they have ever been and the day of the demagogue and the muck-raker seems to have passed, never to return. All this is due, perhaps more than to any other cause, to the higher average of education of the people, who are not to be long deceived by sophistries or false doctrines. In connection with our depression and financial panic it will be remembered that these have not been confined to this country, but have been of world-wide extent. Readjustments, however, seem to have been largely, if not entirely, completed and before long we will be wondering how it all came about and why, when the opportunity presented itself, we did not invest our money to better advantage. The enterprises of the future will undoubtedly be as large and on an even larger scale than in the past. Universal economic development cannot be halted any more than it is possible to prevent electricity from replacing candle light or steam from replacing mule power."

ARIZONA POWER COMPANY.—The Electric Operating Construction Company, of 49 Wall Street, New York, has completed the financing of the Arizona Power Company, 7500-hp water-power development near Prescott, Ariz. William P. Bonbright & Company, of 24 Broad Street, act as fiscal agents, and Viele, Blackwell & Buck are the consulting engineers. The Electric Operating Construction Company will itself manage the construction, and its chief engineer, R. S. Masson, has located at Prescott to direct the work.

COPPER PRODUCTION IN UTAH AND NEVADA.—The Utah Copper Company, controlled largely by Guggenheim interests, is stated to be now producing at the rate of 3,000,000 pounds of copper a month, and it is reported that production will be increased to 4,000,000 pounds, or at the rate of 48,000,000 pounds a year, by the middle of next summer. It is figured that the mine is producing copper at a cost of less than 9 cents a pound. This low cost of production bears out the optimistic statements made from time to time in connection with the low cost of turning out copper in the Bingham camp. The same conditions apply to the copper properties in the Ely, Nev., camp, where the Guggenheims are the controlling factors of the Cumberland-Ely and Nevada Consolidated companies. The concentrator owned jointly by these companies will begin operations by April next and the smelter will be completed in the following month. It is figured that the Cumberland-Ely can produce copper at a cost of 1½ cents a pound below that of the Utah Copper Co. The plant of the company will be put gradually into commission, so that the Cumberland-Ely can produce at the rate of 2,500,000 pounds of copper a month by Aug. 1, 1908. The railroad has been completed to the veteran mine of the Cumberland property. The Cumberland-Ely will require no more financing, and will start business with a substantial working capital.

NOT A "BOOM" YEAR.—"However much conditions in the business world have improved," said W. S. Doran, of the Alberger Condenser Company, in speaking of the general situation, "we cannot expect the year of 1908 to be a 'boom' year. The outlook is excellent, but the political situation always causes affairs to slow up and we must expect things to remain more or less quiet until the political situation has been straightened out and settled. The depression was rather welcomed by many of us. We were far behind in our orders and were glad of an opportunity to come abreast of our business. Incidentally it gave us an opportunity to do a little necessary house cleaning. Just as the depression is commencing to make itself felt we note the signs of business revival. Daily inquiries have been received in increasing volume and a number of large orders. The big contract must not be looked for until after the elections, when the political atmosphere has cleared. Then we may expect to see times as good or better than we ever have seen them before. But the railroads, which are among the heaviest buyers, have been hard hit by the policy of the present administration. Public confidence in their values has been shaken and as a consequence they have not been able to market their bonds. Without money it is impossible for them to go ahead with projected extensions and improvements."

ALLIS-CHALMERS SALES.—The Allis-Chalmers Company reports that within a week it sold machines for motor drives in capacity ranging from 1 to 200 hp to a score or more manufacturing companies distributed throughout the United States. Among these are the Procter-Gamble Company, Cincinnati; Berwind-White Coal Mining Company, Windber, Pa.; Crane & Company, Chicago; Goldfield (Neb.) Consolidated Mines Company; Diamond Match Company, Barberton, Ohio; Cudahy Brothers, Cudahy, Wis.; Goulds Pump Manufacturing Company, Seneca Falls, N. Y. Among other recent sales of the Allis-Chalmers Company are a 300-kw, direct-connected unit for the shops of the Chicago, St. Paul, Minneapolis & Omaha Railroad at St. Paul, Minn.; a 1200-kw, direct-connected, 550-volt unit to the Mobile Light & Railway Company, Mobile, Ala.; a 100-kw alternator to the Seattle-Tacoma Power Company, which supplements an equipment of three large water-wheel generators installed by the same builders in the hydraulic plant of this company.

GENERAL ELECTRIC LAMP FACTORIES.—The General Electric Company has made formal announcement of the erection of four lamp factories in different parts of the country, reference to which has appeared in these columns. The new factories are situated at East Boston, Mass.; Toledo, Ohio; Fort Wayne, Ind., and Newark, N. J. The factory at Toledo will produce only gem filament lamps; at the Newark factory only tungsten filaments will be made, while the factories at East Boston and Fort Wayne will produce regular carbon filament lamps. A new factory building has also been erected at Harrison, N. J., adjoining the present lamp factory, which is devoted to the production of tungsten lamps. It is stated that the total productive capacity of the General Electric Company lamp factories now aggregates 60,000,000 lamps per year.

SALES OF COPPER MINES.—The Summit group of copper mines has been sold by the Phoenix Securities Company, of New York, to the Stauffer Chemical Company, of San Francisco, which has large mining interests at several points in the state. The Summit group of 30 copper claims lies adjacent to the Mammoth. A great deal of development work has been done and enough copper ore uncovered to warrant either the erection of a smelter or the building of a transportation system for the shipment of the ore to the chemical works. The Stauffer Chemical Company took a bond on the Summit in May. The bond has nine months more to run, but the company was so well pleased with the property that it was willing to pay cash for the mine before the bond expired, a discount being made for the early payment.

WESTINGHOUSE LAMP COMPANY RECEIVERSHIP.—On Feb. 24 the matter of the discharge of the receivers for the Westinghouse Lamp Company will come up in the United States Circuit Court, in Newark. It is stated that 98 per cent in amount of the creditors having claims in excess of $500 have signed an agreement consenting to the extension of the time of payment until Jan. 1, 1909, and to the turning over of all assets and property in the hands of the receivers to the company. The net profit from the business from Oct. 26 to Dec. 31 was $34,129.33. The receivers have on hand $91,620, which will be sufficient, after paying the expenses of the receivership, for the payment of all accounts and notes under $500 with interest, and leave a balance sufficient to continue business safely.

ANOTHER OPTIMIST.—Mr. R. B. Corey, of the R. B. Corey Company, speaking of the outlook in the contracting and engineering supply field, sees a marked improvement in the present conditions and the prospects for the future. "There is a better feeling throughout the business world," he said; "the increase of money in the banks and the consequent easing of the money situation has done as much as anything to restore confidence. Dealers in electrical supplies and electrical contractors are buying more freely than for some time and every indication seems to point to a good business year."

ELECTRICAL MACHINERY FOR CHILI.—Recent shipments to customers in Chili by J. K. Robinson, representing the Westinghouse Electric Company and the Westinghouse Machine Company, in Chili, Bolivia, Peru and Ecuador are as follows: Two 85-kw generators, 30 motors, 2 double-drum electric hoists; to another concern, one 85-kw generator, 15 motors and one double-drum electric hoist; to a third customer, 2 Gould triplex electric pumps for pumping petroleum, operating 1500 pounds to the square inch. The shipments include a Robbins belt conveyor and 20 silent chain drives, using Morse chains.

MEXICAN MINE EQUIPMENT.—The General Electric Company is furnishing the entire electrical equipment for the Tajo Mines, in the Rosario district of Mexico. The order includes a three-phase, 60-cycle, 2300-volt revolving-field generator of 150-kw capacity; nine oil-cooled transformers; three 440-volt induction motors of 15, 35 and 75-hp capacity, with starting compensators; two-circuit feeder panel; complete lightning arrester equipment, and the necessary wire, insulators, etc.

CURTIS BATTERY COMPANY.—The Curtis Battery Company, of Minneapolis, Minn., has been reorganized, and has started work on the manufacture of the Curtis battery, making a specialty of batteries for train lighting. The directors of the company are: W. W. Heffelfinger, E. C. Best, W. W. Leonard, C. W. Hack, C. W. Gardner, of Minneapolis, and A. W. Trenholm and G. Scholle, of St. Paul.

JANUARY BETTER THAN DECEMBER.—"Things are quiet now," said C. H. Florandin, of the C. & C. Electric Company, when asked about the outlook in the electrical field for the coming year, "but business has shown a marked improvement in January as compared with December. If the improvement continues throughout the year in the same ratio there should be no complaints coming from anybody."

THE PENNSYLVANIA ROYAL ARC LAMP COMPANY has been incorporated to market the "Royal" flaming arc lamp, made by the Royal Lamp Company, New York. Mr. James R. Dodworth is president, and Mr. Frank B. Ward, general manager of the company.

WESTINGHOUSE ORDERS.—Orders have been received by the Westinghouse Company for $75,000 worth of electrical machinery for Mexican mining, electric light and traction companies.

THE COPPER SITUATION.—The prediction of 12-cent copper for March seems more than likely to be realized, unless there is some decided improvement in the copper situation. On Monday electrolytic broke through 13c. to 12¾c., making the lowest level reported this year, and within ¾ of a cent of the low level for 1907. London, which has been the key to the situation for the last six months, is reported to be stocked with American copper, and the flattening of the London and Continental markets is thought to have forced foreign holders of the metal to throw their stocks on the market at any price. The demand from abroad has been the sustaining feature of the copper market for a long time, and the growing industrial inactivity on the Continent has had a disastrous effect upon the home market. The shipments to London have, of late, been largely speculative in character, and large quantities of the metal have been stored in British warehouses, awaiting an advance in price. The failure of the American market to improve, and the report that the Amalgamated Company is contemplating resumption in many of its mines, have been bear factors which have forced the London dealers to liquidate rather than carry their stocks longer in the face of a declining market. During the last four months Europe has taken in all about 250,000,000 pounds, and declining exports for February indicate the limit has been reached. It cannot be denied that the developments of the copper situation have proved a disappointment to nearly every one. The January indications of a better market for the metal have not been realized. American consumers are not buying in any considerable quantities, but stick to their policy of purchasing only enough for their immediate needs. It is certain that there will have to be a substantial betterment of the business situation before there will be any chance for improvement in the copper market. Electrical consumption of copper also shows no signs of improvement. The large buyers are inclined to look on the market with suspicion. "During the last six months," said a representative for one of the largest consumers of copper in the electrical line, "there has been more manipulation in the copper market than at any during the last six years. I can see nothing at present that might cause copper to go higher, and I can see many causes that might force prices lower. So I am doing like nearly every one else, keeping away from the market as much as possible." At the Metal Exchange on Monday prices were quoted as follows:

	Monday.		Friday.	
	Bid.	Asked.	Bid.	Asked.
Lake	$12.75	$13.50	$13.12½	$13.37½
Electrolytic	12.62½	12.87½	12.87½	13.12½
Castings	12.50	12.75	12.75	12.87½

London metal prices were as follows:

	Opening to-day. £ s. d.	Closing to-day. £ s. d.	Closing Friday. £ s. d.
Copper, spot	57 12 6	57 12 6	58 10 0
Copper, futures	58 0 0	58 c 0	59 0 0
Copper, best selected	62 10 0	62 10 9	63 0 0

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¾
Lake copper, spot	13⅞	12⅞
Casting copper, spot	13½	12⅝
London, spot	£64 5 0	£57 12 6
London, futures	64 10 0	58 0 0
London, best selected	67 10 0	62 10 0

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and weak early in the week, with apparent renewed liquidation and evidences of aggressiveness by bearish speculative interests. Among the weakest features were the Gould stocks, regarding which unfavorable reports were circulated. Reports of better indications in different lines of trade were passed without much notice on the part of the market, but the accumulation of idle cars, with the decreased traffic and earnings of railroad companies which it indicates, formed the basis for not a little talk about further developments connected with cutting down or passing of dividends. The activity throughout was on a rather moderate scale and was concentrated upon a comparatively few issues. At the close of the week a more bullish spirit was in evidence. Electric stocks were weak and closed with net declines, Western Union being the heaviest loser. This stock closed at 46½, which is a net loss of 7 points for the week. The reason for the weakness in Western Union was due, it was stated, to the unsatisfactory financial condition of the company. For the fiscal year ended June 30, 1907, the company reported a surplus over fixed charges and the 5 per cent dividend of exactly $36,053. The recently published earnings for the first half of the year ended Dec. 31 showed net of $688,507, or $177,618 less than was required to pay interest charges. The deficit on that date amounted to $2,611,668. Instead of its being a question of whether or not the regular dividend would be paid, it is a question of how the interest charges will be met. Last January the company paid its quarterly dividend in stock, but up to that time 5 per cent in cash had been paid regularly since 1887. In 1880 it sold as high as 116½, and during 1892, 1893 and 1901 it touched par. The general drift of prices on the curb market was downward, with a temporary rally toward the close, followed by sagging quotations. Following are the closing quotations of Feb. 17:

NEW YORK.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Allis-Chalmers Co.	6	6	Interborough Met. com	7¼	7¼
Allis-Chalmers Co. pfd.	18	17	Interborough Met. pfd.	19½	18¼
Amalgamated Copper	48⅛	46¼	Mackay Cos.	52¾	52
Am. Dist. Tel.	39*	39*	Mackay Cos. pfd.	61	58
American Locomotive	33¾	33	Metropolitan St. Ry.	20½	—
Amer. Locomotive pfd.	87⅞	88	N. Y. & N. J. Tel.	98½	90
American Tel. & Cable.	55	55	U. S. Steel com.	27¼	27⅝
American Tel. & Tel.	106	105	U. S. Steel pfd.	90¼	91½
Brooklyn Rapid Tran.	39¾	38¾	Western Union Tel.	53½	46½
General Electric	115½	114	Westinghouse com.	40	40½
Hudson River Tel.	—	—	Westinghouse pfd.	70	70

BOSTON.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Amer. Tel. & Tel.	105½	—	Mass. Elec. Ry. pfd.	—	42
Cumberland Telephone.	—	—	Mexican Telephone.	—	—
Edison Elec. Illum.	208	205	New England Telep.	—	110
General Electric.	—	114½	Western Tel. & Tel.	—	—
Mass. Elec. Ry.	—	11	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
American Railways	42¾	33	Phila. Electric.	5⅝	5⅜
Elec. Co. of America	8¾	8¼	Phila. Rapid Transit.	15½	15
Elec. Storage Battery.	27	26	Phila. Traction.	—	86
Elec. Stor. Battery pfd	—	—			

CHICAGO.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Chicago City Ry.	172*	172*	Metropolitan Elec. com	17	14
Commonwealth-Edison.	86	84	National Carbon.	—	53
Chicago Subway.	16	—	National Carbon pfd.	—	100
Chicago Tel. Co.	115½	—			

*Asked.

NIAGARA ELECTRICAL DEVELOPMENT COMPANY.—According to a telegram to the New York *Tribune*, William McKenzie, president of the Toronto Railway Company, will advance $3,000,000—$2,000,000 of which is to satisfy creditors and $1,000,000 to be used for developments—to save from liquidation the Electrical Development Company at Niagara Falls. It is stated that as a result of this deal, the Canadian Northern Railway, which is to be extended through Western Ontario, will probably be made an electric system; also that an electric railway will be built from Niagara to Toronto, with running arrangements with the New York Central, and that the Electrical Development Company will supply power to the Grand Trunk for some of its lines in the Niagara district.

NEW YORK STATE ELECTRIC LIGHT MERGER.—The Public Service Commission in the Second District of New York State has finally approved the merger by the Utica Gas & Electric Company with the Herkimer Light & Power Company, the Glens Falls Gas & Electric Company, the Consolidated Light & Power Company, of Whitehall, and 51 per cent of the Union Gas, Electric Light & Fuel Company, of Sandy Hill and Fort Edward. There will be a bond issue of $3,000,000 to carry out the merger.

CHICAGO TELEPHONE.—The annual report of the Chicago Telephone Company shows that the stockholders increased 51 per cent in the last year, and that the American Telephone & Telegraph Company still holds 52 per cent of the stock. The gross earnings were $8,718,951, an increase of about $800,000 over the previous year; the expenses were $6,976,868, an increase of about $700,000 over the previous year. The earnings represent 10.3 per cent on the capital stock.

BELL TELEPHONE REPORT.—The American Telephone & Telegraph Company reports a balance over its operations of $16,269,387 for the year ending Dec. 31, 1907, equivalent to 10.61 per cent on the $353,476,600 capital stock. The assets of the company are reported at $396,357,982, the surplus being $30,738,418.

WEST END STREET RAILWAY BONDS.—The West End Street Railway of Boston has sold $7,000,000 4½ per cent, 15-year bonds to a syndicate composed of Parkinson & Burr, Blake Bros. & Company and E. H. Rollins & Sons.

CHICAGO UNION TRACTION RECEIVERS.—Notice has been given that all claims against the Union Traction Railway, of Chicago, must be filed with the receiver by Aug. 1.

PACIFIC LIGHT & POWER COMPANY.—The Pacific Light & Power Company, of Los Angeles, Cal., according to the report recently filed with the city clerk by Charles Foreman, secretary of the corporation, earned $413,142.55 in profits for its stockholders during 1907. The earnings from light in the city are declared to have been $463,882.82, and from power in the city $525,894.40. The total earnings are reported to have been $1,281,055.01, the inference being that the difference of $291,277.79 represents the proceeds of the sale of light and power outside the city, although it is not specifically so stated. The expenditures for supplying light and power in the city were, for operating, $271,938.66; general expenses, $92,720.50; fixed charges, $74,155.25. For supplying light and power outside the city the expenses were: Operating, $30,215.41; general expenses, $10,302.28; fixed charges, $8,239.47. The expenditures during the year at plants used for gas, railway and water service outside the city and the expenditure for interest totaled $380,340.89, making a total expense of $867,912.46. The total current sold inside and outside the city for light and power aggregated $3,081,120. The possessions of the company are stated as follows: Land, $507,763; transmission and distributing systems, $3,991,228.37; horses, wagons and harness, $12,723.70. Replacements are valued at $586,667.81, making the alleged actual cost of properties $7,233,274.51.

WESTERN ELECTRIC BOND ISSUE.—Dispatches from Chicago state that President Barton, of the Western Electric Company, said, when asked what had become of the "proposed bond issue": "We have done nothing about it and are not likely to in the near future. The necessity for a bond issue has largely ceased. Besides, there is no bond market. Our indebtedness is considerable; it is large in the aggregate, but not larger than we can carry comfortably as a floating debt. The tendency of money rates is downward, and our policy is further to reduce our debt. We consider our financial position a favorable one at present. The present volume of orders ahead and for immediate use is small. We do not see anything in the immediate future to lead us to expect any substantial increase. We thought we saw signs of a revival in November and December, and our business did improve somewhat, but during January orders were very light. We are not looking for any early improvement. Our first effort now is to adjust expenses to the volume of business. We had the misfortune of three years' profits compressed into one year. We are paying the penalty for too much success."

MACKAY COMPANIES' REPORT.—The annual report of the Mackay Companies, a holding corporation for the Postal Telegraph & Commercial Cable Companies, as well as the owner in whole or in part of the stock of 102 cable, telephone and telegraph companies of the United States, Canada and Europe, gives the receipts for the year ending Feb. 1 as $3,330,390. The value of the companies' investments is about $92,075,593. The capital outstanding consists of $50,000,000 preferred and $41,380,440 common stock. The companies have been earning during the past quarter more than is necessary for the dividends of preferred and common stocks, notwithstanding the general business depression. Dividends of 4 per cent have been paid on each class of stock. The report states that the Mackay Company continues to be the largest stockholder in the American Telephone & Telegraph Company, and during the year subscribed through the Commercial Cable Company for its proportion of the new stock issued in June, 1907, by the telephone company.

APPLICATION FOR RECEIVER FOR UNITED STATES INDEPENDENT TELEPHONE COMPANY.—An application has been made to adjudge the United States Independent Telephone Company insolvent and place it in the hands of a receiver. The capital stock of the company is $50,000,000, of which $42,576,000 has been issued. At present the company has no president; the first vice-president is John N. Rouher, and the secretary and treasurer, W. Roy McCanne, both of Rochester, N. Y. Adolph Busch, of St. Louis, is stated to be one of the 24 directors. The assets of the company are declared to be large interests in the Rochester Telephone Company, the Stromberg-Carlson Telephone Manufacturing Company, the New York Independent Telephone Company, and the Utah Independent Telephone Company. The application for receivership was made by James M. E. O'Grady, of Rochester, N. Y. Justice Foote, at Rochester, on Monday, granted a motion asking that Henry W. Conklin be appointed receiver for the United States Independent Telephone Company. Ex-Justice Nash, who made the motion, is reported to have appeared as a trustee of the Security Trust Company. Receivership proceedings will also come up this week at Newark, N. J., on motion of the attorney of the United States Independent Bondholders' Protective Association.

HUDSON COMPANY BOND ISSUE.—Through Harvey Fisk & Sons, bankers, the Hudson Companies offer $5,000,000 of an issue of 6 per cent gold notes, with $15,000,000 as the limit of the issue. These notes are issued to complete and equip the system of the Hudson & Manhattan Railroad Company, which owns and will operate the four tunnels under the Hudson River connecting Jersey City and Hoboken with New York City. They are offered at 98½ and interest, yielding more than 6½ per cent per annum, and are secured by the pledge of the Hudson & Manhattan Railroad Company first mortgage 4½ per cent convertible gold bonds, due 1957, at the rate of $1,500 par value of bonds for each $1,000 note outstanding. The first mortgage 4½ per cent bonds are secured by a first lien upon all the property of the Hudson & Manhattan Railroad Company.

DIVIDENDS.—The directors of the Susquehanna Railway, Light & Power Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 2. Directors of the American Railways Company have declared the regular quarterly dividend of 1½ per cent (75 cents per share), payable March 16. The directors of the Susquehanna Railway, Light & Power Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 2. The directors of the Kansas City Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 2. The directors of the Rochester Railway & Light Company have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 2.

WESTINGHOUSE PLAN PROGRESSING.—As a result of the letter sent out by the Westinghouse Reorganization Committee to the creditors of the company, urging them to deposit their claims with the committee, it is announced that deposits are being made in a highly satisfactory manner, and it seems more than likely that the agreement and plan for the readjustment of debt will be successfully carried out. The depositories are the Bankers' Trust Company, New York, N. Y.; the First National Trust & Savings Bank, Chicago, Ill., and the First National Bank of Pittsburg, Pa. On March 1 the committee will meet to determine whether or not the plan may be put into operation.

THE DOSSERT SOLDERLESS CONNECTOR COMPANY.—The annual report of Dossert & Company for 1907 showed an increase in gross business of 27.5 per cent notwithstanding a falling off in the last quarter owing to the slowing down of construction work. It is stated that there has been a marked increase of orders, however, since the first of the year, the figures for January showing a large increase over the same month last year.

ROCKY MOUNTAIN BELL TELEPHONE.—President Lane, of the Rocky Mountain Bell Telephone Company, states that the reason for passing the quarterly dividend of the company is the serious manner in which its business has been affected by the closing down of coal and copper mines and smelters and the unsettled condition of labor, particularly in Montana. He is unable to say when dividends will be resumed.

MEXICAN LIGHT & POWER COMPANY.—The report of this company, which controls the hydro-electric plants on the Nexcaca and Tenango rivers, shows earnings from all properties in 1907 of $4,930,370 and net earnings of $1,490,114. The net earnings showed an increase of $415,000 over 1906. The property and franchise concessions are valued at $26,825,000 and the total assets at $30,888,000.

ELECTRIC STORAGE BATTERY.—In connection with the annual meeting of the Electric Storage Battery Company, on March 18, it has been reported that the par value of the stock will then be reduced from $100 to $50 per share. We are informed through an official source that there is no truth in this report.

PRESIDENT BARTON NOT TO RESIGN.—It is reported that President Barton of the Western Electric Company will not resign as rumored. To relieve him of much of the great amount of work he has been doing, the report says, he will shift some of his duties to younger men.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

CENTERVILLE, ALA.—The Centerville Power Company is considering the question of erecting a dam across the Cahaba River.

GUNTERSVILLE, ALA.—A company is being organized to establish an electric light plant in this place. V. V. Moore is interested in the project.

HUNTSVILLE, ALA.—The City Council is agitating the question of erecting a municipal electric light plant. The present contract with the Huntsville Railway, Light & Power Company expires at the end of this year, and as the Council has the power to make an issue of bonds for the purpose of establishing a municipal plant there is some discussion on the subject.

PRESCOTT, ARIZ.—Arrangements have been completed by the Electric Operating Construction Company, of New York, N. Y., for the financing of the Arizona Power Company, which proposes to erect a 7500-hp hydro-electric plant near Prescott. The Electric Operating Construction Company will take charge of the construction of the plant, and R. S. Masson, its chief engineer, has located at Prescott to direct the work. Viele, Blackwell & Buck, 49 Wall Street, New York, N. Y., are the consulting engineers.

COTTON PLANT, ARK.—The question of establishing an electric lighting plant in this town is under consideration. E. P. Ford, of St. Louis, Mo., is interested in the enterprise.

LESLIE, ARK.—The Williams Cooperage Company is making extensions to its electric light system.

LOS ANGELES, CAL.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until March 17, for the installation of a conduit and electric wiring system for the U. S. court house and postoffice building at Los Angeles.

NEWMAN, CAL.—The Newman Light & Power Company contemplates erecting about 16 miles of new transmission lines. J. McDonald is president.

REDDING, CAL.—The Board of Trustees has awarded the contract for city lighting for the ensuing year to the Northern California Power Company for $208.05 per month. The contract calls for 33 arc lamps on the streets, a number of lamps for alleys and the lamps in the city hall. The new contract takes effect within 60 days.

REDLANDS, CAL.—The Southwestern Home Telephone Company has taken over the plant of the Pacific Telephone & Telegraph Company in this city.

SACRAMENTO, CAL.—The City Trustees have accepted the offer of the Sacramento Electric, Gas & Railway Company to furnish arc lamps for lighting the streets of the city at the rate of $6.30 per lamp per month for the ensuing year. The street lighting system now consists of 550 arc lamps. The city has been contemplating establishing a municipal electric light plant, and recently appointed Prof. C. L. Cory, of San Francisco, to investigate the cost of installing a plant. According to the report submitted by Prof. Cory to the Trustees, on a basis of 600 lamps, it would cost the city for the construction and operation of its own plant at the rate of $6.70 per lamp per month at the least. The cost of installing a plant to supply electricity for 600 arc lamps is estimated at $237,000, and for installing an incandescent system for lighting the city hall, library and other public buildings is estimated at about $18,000, making the total cost of the plant about $250,000. Under the circumstances the Trustees do not think it advisable to install a municipal plant at this time. The city has been paying at the rate of $7 per lamp per month. The new contract takes effect from Feb. 1.

DENVER, COL.—The Denver Gas & Electric Company is contemplating making improvements and extensions to its plant, the cost of which is estimated at $50,000. F. W. Frueaff is vice-president of the company.

HARTFORD, CONN.—The State Railroad Commissioners have issued an order giving the Shore Line Electric Company power to condemn certain pieces of land in the towns of Essex and Old Saybrook for the right of way for an electric railway.

SCOTLAND, CONN.—Bids will be received until March 2 by the Uncas Power Company, Norwich, Conn., for the completion of the power house above the foundations now in place, also for building a reinforced concrete dam on earth bottom about 200 feet in length and for a 25-foot head, located on the Shetucket River at Scotland, Conn., on the New York, New Haven & Hartford Railroad, including also certain embankments and other accessories.

JACKSONVILLE, FLA.—Sealed proposals will be received by the trustees for the Water Works and Improvement Bonds of the city of Jacksonville until March 4, for one Hamilton Corliss tandem compound engine, one General Electric 250-kw, 2300-volt, belted monocyclic generator with exciter. The machinery is now in use, but will be ready for delivery about April 1. For further information apply to R. N. Ellis, superintendent.

ATLANTA, GA.—The officials of the Southern Bell Telephone Company estimate the damage to its lines by the recent storm from $110,000 to $137,000, the loss in Atlanta is estimated from $10,000 to $12,000 and from $100,000 to $125,000 on the long-distance lines.

MACON, GA.—The Macon Railway & Light Company has purchased a 2,000-hp steam turbine from the Westinghouse Electric & Manufacturing Company for $58,000. The company has also reduced the price of electricity from 15 cents to 12 cents per kw-hour.

MACON, GA.—It is reported that the Macon Railway & Light Company has awarded contracts for new power house equipment, consisting of a new turbine and generator, at a cost of $53,000. The new machines will develop 2500 horse-power and will be installed this spring. W. J. Massee is president.

MACON, GA.—The Macon Railway & Light Company has reduced the price of electricity for lamps from 15 cents to 12 cents per kw-hour, with an additional 10 per cent reduction on all bills paid before the tenth of each month. The new schedule took effect Feb. 1.

MILLEDGEVILLE, GA.—Plans are being made by the Oconee Milling Company for the development of about 800 horse-power on the Oconee River.

QUITMAN, GA.—The City Council has granted a franchise to the Thomasville and Valdosta Electric Street Railway & Power Company to construct an electric railway on the principal streets of the city. The railway will also connect Quitman with Valdosta, Thomasville and Blue Springs.

SANDERSVILLE, GA.—The city has recently purchased a 150-kw Westinghouse generator, and a 225-hp tandem compound Skinner engine for the municipal electric light and water works plant. Arthur Pew, Temple Court, Atlanta, Ga., is engineer.

WEISER, IDAHO.—O. F. Markhus, general manager of the Oxbow power project, it is said, will present a proposition to the City Council to buy or lease the municipal electric light plant or to furnish electrical energy from his plant to operate the city system. Mr. Markhus expects to have his plant ready for operation by July 1.

CANTON, ILL.—Orders have been placed by the Illinois Central Electric Railway Company with the Ohio Brass Company, of Mansfield, Ohio, for six miles of overhead equipment, and with the Danville Car Company for two cars. The company also contemplates extending its railway to Norris, a distance of five miles, in the near future.

CARTERVILLE, ILL.—The local electric light plant owned by A. C. Hope & Sons was recently destroyed by fire.

CHICAGO, ILL.—The Commonwealth-Edison Company is contemplating the construction of a three-story power house at 2438 Twenty-fifth Street, at a cost of $100,000.

CHICAGO, ILL.—The City Council has decided to extend the street lighting system and will install 5500 additional street lamps. Electrical energy for supplying the additional lamps will be secured from the Sanitary District of Chicago.

CHICAGO, ILL.—The Drainage Board of the Sanitary District of Chicago has entered into a contract to supply the Winthrop Asphalt Shingle Company, the Shaving & Sawdust Company and the McDonnell & Brennan Company with electrical energy for lamps and motors for a term of five years, at the rate of 2½ to 9 cents per kw-hour.

QUINCY, ILL.—Negotiations have been consummated by the directors of the St. Louis, Terre Haute & Quincy Traction Company for the purchase of two short interurban lines running from Roodhouse to Virden, and from Virden to Taylorville. The company has secured the right of way for three-quarters of the distance, 142 miles, between Quincy and Taylorville. It is said that construction work will commence in the spring.

BLOOMINGTON, IND.—The Citizens' Telephone Company, recently incorporated, is in the market for material, equipment and expert labor for the construction of a new telephone exchange and system. William H. Adams is president.

BROWNSTON, IND.—A new dynamo and pump have recently been installed in the municipal electric light and water plant. D. B. Vance is manager.

FORT BRANCH, IND.—The citizens are considering the question of purchasing the plant of the Fort Branch Electric Light & Power Company to be operated as a municipal electric light plant.

FRANKFORT, IND.—A company has been organized to promote the building of a new electric railway from Kokomo through Frankfort to Terre Houte. The officers of the company are: Dr. Oliver Gard, of Frankfort, president; J. C. DeWeese, of Kokomo, first vice-president; D. W. Bolden, of Indianapolis, secretary, and E. B. Swift, of Kokomo, treasurer. The capital stock of the company will be placed at $3,000,000.

INDIANAPOLIS, IND.—The State Board of Agriculture is advertising for bids for the construction and equipment of an independent electric light plant on the State Fair grounds. The cost of the plant is estimated at $28,000. Rubush & Hunter, Fitzgerald Building, are the architects.

LAFAYETTE, IND.—The City Council has passed an ordinance providing for the submission to the voters of a proposition to erect a municipal light plant advocated by Mayor Durgan.

SPRING LAKE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has installed at its power house in Spring Lake a new generator, direct-connected to a 2250-hp steam turbine.

WARSAW, IND.—The Commercial Club has passed resolutions in favor of municipal ownership and requested the City Council to purchase the Winona Water & Light Company's plant while the opportunity is offered.

COUNCIL BLUFFS, IA.—Announcement has been made by the Omaha & Council Bluffs Street Railway Company that the extension from Council Bluffs to the State School for the Deaf will be constructed in the near future.

DES MOINES, IA.—The Des Moines City Railway Company contemplates enlarging its power house and adding 1500 horse-power, making the maximum output of the station 6500 horse-power. The improvements will probably be made this spring.

LAKE CITY, IA.—A plan is being considered for the construction of an interurban railway from Lake City to Jefferson, and thence to Perry, where connections will be made with the Des Moines Interurban Railway Company. The railway will be about 44 miles in length, and it is stated that the officials of the Des Moines Interurban Railway have offered to furnish electrical energy to operate the road. The leading men of the three above named cities are interested in the project and have raised sufficient funds to make a preliminary survey of the road.

HERINGTON, KAN.—Bids will be received by C. H. Randall, chairman Water and Light Commission, until Feb. 24, for the construction of an electric light plant and water-works system as follows: Construction of power house; installing tubular boilers, feed water heater and boiler feed pump; one 500-gallon, compound, non-condensing pump; one 750-gallon fire pump; one 150-kw, 2300-volt, 60-cycle generator; two constant-current transformers; 45 alternating-current lamps; one three-panel switchboard; one four-valve engine; also furnishing and erecting water tower, 120 ft. in height, with 70,000 gallon water tank; constructing reservoir, three 8-in. wells with necessary piping, and one 10x12x10 air compressor; also furnishing and laying water pipe, etc. Plans and specifications are on file at the office of the Water and Light Commissioners, and may also be seen at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo.

OPOLIS, KAN.—The question of establishing an electric light plant in this town is under consideration.

SALINA, KAN.—The Salina Street & Interurban Railroad has been sold to Robert A. Handy, of Denver, Col. It is said that steps will be taken to improve the road and increase the number of cars.

WICHITA, KAN.—We are informed that the Wichita Railroad & Light Company contemplates placing contracts during the next 10 weeks for the construction of three miles of track.

BOWLING GREEN, KY.—The Bowling Green Railway Company is constructing a new power station and announcement has been made that the company will erect a car house near the new power plant. The company is also planning to purchase two new cars. H. D. Fitch is manager.

LOUISVILLE, KY.—The Louisville Lighting Company is contemplating extensive improvements to its plant, the cost of which is estimated at $1,500,000. F. M. Sackett is president.

MURRAY, KY.—The proposition to issue $19,000 in bonds for construction of an electric light plant and water works system was defeated at an election held Feb. 12.

LAKE PROVIDENCE, LA.—E. J. Berry, manager of the municipal electric light plant, writes that a 75-hp boiler will soon be installed in the plant.

LEWISTON, ME.—The Lewiston, Augusta & Waterville Street Railway Company proposes to erect two sub-stations to be located at Monmouth and Vassalboro. The contract for electrical equipment has been awarded to the General Electric Company, of Schenectady, N. Y.

LUBEC, ME.—The plant of the Lubec Electric Light Company was sold at auction Feb. 3, in default of the payment of taxes, the purchaser being C. L. Pike. The owners of the plant, it is understood, have a year to redeem the property.

SHARPSBURG, MD.—The Burgess and Commissioners of Sharpsburg have awarded a franchise to John C. Livers to operate an electric light plant to furnish electricity for lighting the streets and for commercial purposes. The contract calls for 55 arc lamps. Electrical energy for operating the system will be furnished from the power plant on the Potomac River at Shepherdstown.

BERLIN, MASS.—A movement has been started toward having the streets of the town lighted by electricity. The Board of Selectmen is making inquiries as to the cost of securing electricity from the plants in Clinton, Hudson and Marlboro. Arthur Hastings, one of the members of the board, favors the establishment of a municipal plant.

BOSTON, MASS.—The State Board of Gas and Electric Light Commissioners has approved of an issue of 2000 shares of capital stock by the Charlestown Gas & Electric Company, to be offered to the stockholders at $100 per share. The proceeds of 1680 shares are to be applied to the payment of an equal amount of promissory notes outstanding Dec. 31, 1907, and the proceeds of 320 shares to the payment of the cost of additions to plant subsequent to that date.

CLINTON, MASS.—The reduction promised several months ago by the Clinton Gas Company went into effect Feb. 1. The rate is on a sliding scale, offering discounts to those paying their bills before the 10th of each month, a reduction of from 10 to 50 per cent, according to the amount of electricity used, making the net rates from 18 cents to 10 cents per kw-hour.

FRANKLIN, MASS.—The Board of Selectmen has entered into a contract with the Union Electric Light Company for lighting the streets of the town for a term of three years, with the privilege of extending it to five years. The street lighting system consists of 43 arc lamps and 55 incandescent lamps of 32 cp, to be operated by one of three following schedules, to be chosen by the Selectmen: Schdule 1 calls for service until 1 a. m. on a moonlight schedule, total number hours of service not to exceed 1800, at a cost of $4,000 per year and $75 per year for each additional arc lamp and $15 per year for each additional incandescent lamp. Schedule 2 calls for service every night until 1 a. m. week days and until midnight Sunday, the total number of hours not to exceed 2200, at a cost of $4,320 per year and $80 for each additional arc lamp and $16 for each additional incandescent lamp. Schedule 3 calls for all-night and every night service for $5,620 per year and $100 per year for additional arc lamps and $24 per year for additional incandescent lamps. The company also agrees to erect a transmission line from the Woonsocket power station and furnish a 24-hour service, and also agrees at that time to reduce the price of electricity for commercial lighting. The town has the right to cancel the contract if the company fails to live up to the terms.

ORANGE, MASS.—Arrangements are being made by the Rodney Hunt Machine Company for building a concrete dam at the Partridgeville mill privilege recently purchased by the company. The dam when completed will furnish power to generate electricity for the operation and lighting of the plant of the Rodney Hunt Machine Company and to other concerns.

SCITUATE, MASS.—The citizens are making an effort to have the streets of the town lighted by electricity, and a petition is being circulated asking the Cohasset Electric Light Company to furnish electrical energy for the purpose.

HOUGHTON, MICH.—Application has been made to the City Council by the South Range Street Railway Company for a franchise to construct and operate a street railway in the city. The company proposes to construct an electric railway from Houghton to South Range. James T. Healy is interested in the enterprise.

DULUTH, MINN.—H. J. Rich, of this city, has secured the contract for installing engines, generators and ventilating system in the addition to the Board of Trade Building, to cost about $7,000.

ST. PAUL, MINN.—Notice has been filed with the city clerk by the Minneapolis Rapid Transit Company of its proposed extensions of track in the city during the coming year, aggregating several miles.

COLLINS, MISS.—The City Council has decided to issue $4,000 in bonds, the proceeds to be used to improve the water and light plants.

LONG BEACH, MISS.—The Town Council has voted to have Jeff Davis Avenue lighted with electricity from the beach to the Louisville & Nashville Railway tracks.

WAYNESBORO, MISS.—The citizens have voted to issue $12,000 in bonds for the construction of an electric light plant.

ST. JAMES, MO.—An election will be held Feb. 25 to vote on the proposition submitted by Chris. Koeln, of St. Louis, for the operation of an electric light plant.

HARLOWTON, MONT.—The Harlowton Light & Water Company, recently incorporated, contemplates the construction of a water and light system at a cost of about $30,000. L. D. Glenn is secretary of the company.

NORTH PLATTE, NEB.—We are informed that the North Platte Electric Light & Power Company contemplates making improvements to its plant, the cost of which is estimated at $15,000. L. W. Walker is treasurer and manager.

PAWNEE CITY, NEB.—The Pawnee City Telephone Company contemplates the construction of a new central station in the near future, plans for which have been received. The cost of the building is estimated at from $3,500 to $4,000.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company has decided to commence work on the construction of the new long-distance toll lines into Omaha as soon as the weather will permit, and will also establish exchanges in Alvo and Murdock.

STANTON, NEB.—M. M. Neumann is said to have petitioned for a franchise to establish an electric lighting plant here.

MANHATTAN, NEV.—The Nevada-California Power Company contemplates extending its transmission lines from Tonopah to Manhattan during the coming summer. The company will also extend its lines up the valley to Round Mountain.

RENO, NEV.—A petition has been presented to the City Council by S. H. Wheeler and Charles H. Burk asking for a franchise for a street railway on most of the streets in the southeastern section of the city.

CONCORD, N. H.—The Concord Electric Company is contemplating the construction of a steam plant to be used as an auxiliary to the Sewall's Falls power plant. It is expected to have the plant installed and ready for operation by next fall.

ASBURY PARK, N. J.—The Atlantic Coast Electric Railway Company is installing three 500-kw Westinghouse Parsons turbo-generators in its power station.

ASBURY PARK, N. J.—The New Jersey Consolidated Water & Light Company, of Deal, is contemplating making a bid for lighting the streets of Asbury Park and has asked the City Council to defer making a contract for street lighting pending a proposition which the company would make to install an underground system and ornamental poles in the city, at a rate much less than is paid under the existing contract with the Atlantic Coast Electric Light Company.

ATLANTIC, N. J.—Bids will be received by the city clerk until Feb. 24 for furnishing lighting standards as follows: Sixty-five corner lighting standards, type "A"; 13 corner lighting standards, type "B," and 200 intermediate lighting standards. Blue prints of the standards will be exhibited at the office of the city engineer, Bartlett Building, Atlantic City, and at the office of Carrère & Hastings, 225 Fifth Avenue, New York, N. Y., architects, where blank forms of proposal, contract and specifications can be obtained. J. W. Hackney is engineer.

COLUMBUS, N. J.—The citizens of this town are agitating the question of having the town incorporated into a borough for the purpose of securing better street lighting service and other improvements.

LOCKPORT, N. Y.—The Common Council has awarded the contract for furnishing electrical energy to the new pumping station of the Lockport water works system at North Tonawanda to the Tonawanda Light & Power Company. The contract is for a term of five years and the cost is estimated at about $6,000 a year.

NIAGARA FALLS, N. Y.—Representative Alexander has introduced a bill in the House of Representatives to grant the Lower River Power & Water Supply Company permission to divert 40,000 cubic feet of water per second for power development. The Ontario Power Company interests hold the State right under which the company was created.

LA GRANGE, N. C.—The officials of the town are considering the question of granting a 10-year franchise to the Joyner Mill Company to furnish electricity for lamps in the town.

SALISBURY, N. C.—A movement is on foot to have the Southern Power Company extend its transmission lines from Charlotte to Salisbury at an early date. The plan is to co-operate with the Salisbury-Spencer Railway Company in the distribution of electricity for lamps and motors in the two towns. If the Southern Power Company extends its lines to Salisbury the local company will install new and improved machinery in its power plant.

SALISBURY, N. C.—Col. John S. Henderson, the recently appointed receiver for the Whitney Company, near Salisbury, N. C., is making active preparations to continue the work of completing the $5,000,000 hydro-electric development on the Yadkin River. At present 500 men are engaged on the work and the receiver believes that power will be available July 1. T. J. Jerome, of Salisbury, and D. W. Noell, of New York, N. Y., have been named as attorneys for the receivers. The T. A. Gillespie Company is the contractor, while the defendant company is represented by Burton Craige, of Salisbury.

THOMASVILLE, N. C.—The new electric light plant of the Thomasville Light & Power Company is nearly completed and will be placed in operation about March 1.

WASHINGTON, N. C.—It is proposed to make a canvass of the town offering a 24-hour service for lamps and motor, and if a sufficient demand exists the municipal electric light plant will be made adequate to meet the increased demand.

RAPID CITY, N. D.—The Rapid City Electric & Gas Light Company will establish a day circuit about March 15. A. Emerick is manager

CAMDEN, OHIO.—Charles S. Houston has purchased the plant of the Camden Electric Light Company and will at once apply to the Village Council for a franchise and a contract for the street lighting.

ROCKFORD, OHIO.—A special meeting of the stockholders of the Cleveland & Buffalo Transit Company will be held March 14 to vote on the proposition of increasing the capital stock from $1,000,000 to $1,500,000.

AFTON, OKLA.—The city will hold an election to vote on the proposition of issuing bonds for the construction of an electric light plant.

CUSTER CITY, OKLA.—The Custer City Commercial Club is considering the question of establishing an electric light plant in the city.

MUSKOGEE, OKLA.—We are informed that contracts will be placed by the Muskogee Electric Traction Company for the construction of 2½ miles of track in the near future.

SAPULPA, OKLA.—The Sapulpa Lighting & Power Company is contemplating the installation of a 100-kw generator and a 150-hp gas engine. E. C. Reynolds is president and general manager.

HEPPNER, ORE.—The City Council is contemplating changing the street lighting system, and will replace the present arc lamps with incandescent lamps of 25 and 16 candle-power.

WALLOWA, ORE.—The City Council has granted a franchise to the Wallowa Mercantile Company to construct and operate an electric light and power plant in Wallowa.

BEAVER FALLS, PA.—Arrangements have been made for the construction of the Pittsburg, Lisbon & Western Railroad from Darlington to Morado Park above Beaver Falls. It is proposed to equip the railroad to be operated by electricity for the entire distance between Lisbon and the Beaver Valley. It is said that a survey has been made and a portion of the right of way secured, and that active work on the construction of the road will commence in the spring.

HARRISBURG, PA.—The Central Pennsylvania Traction Company has applied to the City Council for a franchise to extend its lines on certain streets in East and West Harrisburg.

NEWTOWN, PA.—The plant and holdings of the Newtown Electric Light & Power Company have been purchased by the Bucks County Electric Railway Company. Extensive improvements will be made at once to the power house.

SHAMOKIN, PA.—The Borough Council has adopted an ordinance authorizing the chief burgess and secretary to enter into a contract to provide for lighting the streets and public places of the borough with arc and incandescent electric lamps. John Drumheiser is chief burgess.

TYRONE, PA.—The new plant of the Home Electric Light & Heating Company is rapidly nearing completion. The equipment of the plant will consist of two 500-kw, three-phase, 2300-volt Curtis steam turbines; two 300-kw rotary converters to furnish electrical energy for the electric railway, and also a storage battery for the same purpose. The boiler room is equipped with a battery of 1000-hp Stirling boilers; space is reserved for additional boiler equipment of 1500 hp, and foundations have been placed in the generating room for a 1000-kw generator. The electrical equipment was furnished by the General Electric Company, of Schenectady, N. Y. The cost of the plant is estimated at $200,000 and will be ready for operation in April.

WILMINGTON, PA.—The officials of the Westminster College, located at Wilmington, have organized a company for the purpose of constructing an electric railway between New Castle and New Wilmington, a distance of 10 miles.

PAWTUCKET, R. I.—Frank Harrop, superintendent of street lights, in his annual report submitted to the Board of Aldermen, recommends that an incandescent lighting system be installed on the outskirts of the city, and also recommends an all-night service in the city instead of until 1 a. m. as at present.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Company is reported to have made arrangements with the Wilson & Baillie Manufacturing Company, of New York, N. Y., for completing the construction of its plant at Hales Bar, 12 miles below Chattanooga. Legal complications interfered with the completion of the previous contract. This plant will insure permanent improvement for navigation on the Tennessee River and provide a hydro-electric development with ultimate output of 56,000 horse-power. A dam 1200 ft. long, 50 to 60 ft. high above rock bottom of the river, of masonry and concrete construction. The power house will be 60 x 320 ft., and the equipment will consist of 14 units of 4000 horse-power each, 10 of which will be installed before the end of 1909. Electricity will be transmitted at 60,000 volts to a substation near Chattanooga, where it will be transformed and distributed for lamps and motors. The company will erect a double transmission line, each to have three copper cables supported on steel towers. The construction also includes a 300-ft. lock, 60 ft. wide. The plans were prepared by the U. S. army engineers and engineers of the company and approved by the chief engineers of the army. John Bogart, 16 Exchange Place, New York, N. Y., is engineer for the company.

MEMPHIS, TENN.—There is now pending before the Council a proposition from the Consolidated Gas & Electric Company to furnish the city with arc lamps at the rate of $75 per year, in case the city agrees to use 1000 lamps. The city has now in use 750 lamps, for which it is paying at the rate of $85 per year.

BASTROP, TEX.—The plant and holdings of the Bastrop Water & Light Company have been sold to Robert Bayne, of Fort Worth, subject to the ratification of the stockholders.

CLARENDON, TEX.—The Clarendon Water, Light & Power Company is contemplating improvements to its plant, the cost of which is estimated at $10,000. T. S. Kemp is local manager.

FALFURIAS, TEX.—The Falfurias Telephone Company has increased its capital stock from $5,000 to $7,500.

FORT WORTH, TEX.—The City Council is considering the question of enlarging the municipal electric light plant so as to furnish electrical energy for 900 additional arc lamps. New machinery will be installed, the cost of which is estimated at $50,000. Samuel Davidson is city commissioner.

SAN ANTONIO, TEX.—The San Antonio Traction Company will purchase 10 semi-convertible cars with General Electric equipment, and will also build an addition to its repair shop and install additional machinery. T. C. Brown is superintendent.

OGDEN, UTAH.—Plans have been completed by the Utah Light & Railway Company for the construction of a large power plant at Devil's Gate, in Weber Canyon. The cost of the plant is estimated at $350,000 and will furnish electrical energy to operate the street railway systems in Ogden and Salt Lake City. Work on the construction of the plant will begin this spring.

ASHLAND, VA.—The Virginia Light & Power Company is making arrangements to construct an electric light system, and has contracted to furnish 300 lamps in the business section of the city.

CHRISTIANSBURG, VA.—It is reported that the Montgomery Electrical Company will absorb and operate the Grayson Electric Corporation and municipal lighting system of Christiansburg and Cambria. The general offices of the company are at Christiansburg, and the officers are J. L. Vaughn, president; E. S. Hagan, vice-president, and A. A. Phlegar, Jr., secretary and treasurer.

DILLWYN, VA.—It is reported that an electric light plant will be erected in this town at an early date. The proposed plant will furnish electricity for lighting the towns of Dillwyn, Arvonia, Bremo and New Canton.

EMPORIA, VA.—The Emporia Light & Power Corporation contemplates rebuilding its entire system in the spring. E. C. Goodwin is secretary and treasurer.

NATIONAL SOLDIERS' HOME, VA.—Bids will be received until Mar. 2 by John T. Hume, treasurer National Home for Disabled Volunteer Soldiers, National Soldiers' Home, for furnishing material and installing complete two electric motors, one in the main laundry and the other in the bakery.

NORTON, VA.—An election will be held to vote on the proposition to issue $20,000 in bonds for the construction of an electric light plant.

RICHMOND, VA.—The City Council has adopted a resolution appropriating $6,500 for plans and specifications for installing a municipal electric light plant at the old pump house.

ROANOKE, VA.—The Roanoke Railway & Electric Company has sold its property on Earnest Avenue, on which its power station and car barns are located, to the Norfolk & Western Railway Company. The Railway & Electric Company is to remove the buildings and their contents from the property sold, but retains possession for 18 months, during which time the company will build a new car barn on Walnut Street.

VIRGINIA BEACH, VA.—Plans are being considered for the construction of an electric light plant at Virginia Beach to furnish electricity for lamps in the hotels and cottages within the corporation limits. A petition will be presented to the Town Council for a franchise at its next meeting.

CENTRALIA, WASH.—The Centralia Electric Railway & Irrigation Company has applied to the City Council for a franchise to construct a street railway over several streets of the city.

TACOMA, WASH.—Frank L. Davis, city engineer, has submitted to the City Council an estimate of first cost, together with operating expenses and efficiency of a steam power plant to be used for generating electricity for auxiliary lighting purposes. For a 5000-hp plant with a 50 per cent load factor he estimates the cost at $500,000, and the cost of operating the plant, including fixed charges, coal, depreciation, interest, etc., at $285,813 per year, making the cost of the electrical energy to the city 1.31 cents per kw-hour, as against 1.25 cents now paid by the city to the Seattle-Tacoma Power Company, under a five-year contract for 5000 horse-power. For a 5000-hp plant with a 30 per cent load factor the cost of the plant is estimated the same, but the cost for operating, fixed charges, etc., is placed at $198,686, making the price of electricity 1.51 cents per kw-hour. The cost of a 2000-hp plant with a 50 per cent load factor is placed at $275,000, and the fixed charges are placed at approximately $122,374, making the cost of production 1.4 cents per kw-hour. For a 2000-hp plant with a 30 per cent load factor with fixed charges at approximately $88,027, the price for electricity would be 1.68 cents per kw-hour. Both the city engineer and the Commissioner of Public Works favor a water-power plant.

WALLA WALLA, WASH.—Application will be made to the County Commissioners by the Washington & Oregon Traction Company for a franchise to construct an electric railway into the Blue Mountains, and also to tap much of the rich farm lands of this section. The company was recently granted a franchise by the City Council of Walla Walla.

EAU CLAIRE, WIS.—The bids which were submitted to the City Council Jan. 15, for lighting the streets of the city by either gas or electricity for a term of five or ten years, were returned unopened. The City Council is now asking for bids for street lighting with gas or electricity for a term of five years. William Danforth is city engineer.

IOLA, WIS.—E. R. Cushman is reported to be interested in a proposition to establish an electric light and power plant in this town.

LOYAL, WIS.—The citizens have voted to issue $17,000 in bonds for electric light and water works.

MADISON, WIS.—The contract for the dynamos and other electrical equipment for the heating and lighting plant for the new State Capitol has been awarded by the Capitol Commission to the Northern Electric Company, of Madison, for about $42,000, and the contract for boilers to the Babcock & Wilcox Boiler Company, for $14,000.

PORTAGE, WIS.—The State Railroad Commission has issued an order granting the Portage Electric Light Company authority to readjust and increase its rates for electricity. The order may be modified after the property has been valued by the commission.

CHAFFEY, ONT., CAN.—The Muskoka Telephone Company has received a franchise to operate a telephone system here and will extend its line from Rosseau, Yearley and Sprucedale.

EDMONTON, ALB., CAN.—Owing to the delay in installing the telephone system the City Commissioners have cancelled the contract awarded to the Lorimer Automatic Telephone Company, of Toronto, and the company has started suit. The Stowger Company, of Chicago, offers to install a system by April 1, and will pay a forfeit of $25,000 if the system is not installed by that date.

LONDON, ONT., CAN.—A. E. Welch, of this city, has been awarded a contract for the construction of 35 miles of the proposed electric railway to connect this city with Stratford, Ont. Several branch lines are planned.

NEW LISKEARD, ONT., CAN.—The Nipissing Central Electric Railway Company will let a contract early in May for the construction of a section of the railway between New Liskeard and Cobalt. Address F. H. Latchford, New Liskeard.

PORT ARTHUR, ONT, CAN.—Cecil B. Smith has completed the survey of the Dog Lake Falls for the proposed power development for this town. The transmission line will be 23½ miles in length. Address Mayor Carrick.

TORONTO, ONT., CAN.—Alexander Dow, of Detroit, Mich., has placed an outside value of $4,000,000 on the plant of the Toronto Electric Light Company which the city proposes to purchase.

CRESTON, B. C.—Plans are being considered for developing the water power of the Goat River Canyon, three and one-half miles from Creston. A company is being formed to carry out the project.

VANCOUVER, B. C., CAN.—The British Canadian Wood, Pulp & Paper Company has received a grant of water rights on Rainy River, opposite Gambier Island, and will at once proceed with the installation of a plant to develop 5000 hp. Address W. H. R. Collister, 313 Cordova Street, Vancouver, B. C.

YARMOUTH, N. S., CAN.—The Yarmouth Amalgamated Telephone Company is applying to the provincial government to increase its capital from $25,000 to $50,000 for the purpose of making extensions.

OROGRANDE, N. M.—It is reported that the Wachusetts Mining Company of Massachusetts, which is working the Harvey group, will soon install a power plant.

CHIHUAHUA, MEX.—Surveys are being made in connection with the construction of a hydro-electric plant to furnish electrical energy to operate the El Salto mill at the Ocampo mines. It is said that the plant will be installed at once and will also furnish electricity for the Matulera and other mines.

GUADALAJARA, MEX.—Luis H. R. von Ruecau, of Mexico City, is planning the construction of an electric railway from Cuale to the Pacific port of Las Penas. He has a concession for taking water from the Ameca and Mascota rivers, and proposes to generate electricity to operate the proposed railway and for mining purposes.

New Industrial Companies.

THE AMERICAN SIGNAL LIGHT & APPLIANCE COMPANY, of San Antonio, Tex., has been incorporated, with a capital stock of $25,000, by F. Wessel, D. F. Youngblood and others.

THE DAMM ELECTRICAL COMPANY, of New York, has filed articles of incorporation, with a capital stock of $10,000. The directors are Albert Damm, Max Sommer and Charles W. Reed, of New York.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, of Muncie, Ind., has been incorporated for the purpose of doing a general business in electrical work and will carry a large supply of electrical goods. C. C. Radabaugh, who was with the General Electric Company for 30 years, is at the head of the company.

THE IMPERIAL ELECTRIC COMPANY, of Akron, Ohio, has been incorporated, with a capital stock of $180,000, by E. E. Andrews, R. E. Inskeep, William Weaver, W. C. Hall and A. C. Linzee. The company proposes to purchase the plant and equipment of the Akron Electrical Company, located in South Akron, and is practically a reorganization of the old company.

THE NATIONAL COMPANY, of South Bend, Ind., has been incorporated for the purpose of carrying on a general contracting business, making a specialty of constructing and equipping electric light plants, water works, heating systems and a general engineering business. The company will also manufacture contractors' tools suitable for all kinds of construction work. J. F. Cole, R. W. Miller and G. A. Harrop are the directors.

THE WESTERN GAS ENGINE COMPANY, of Los Angeles, Cal., has increased its capital stock by $40,000. This increase in the capital brings the total amount now paid in up to $131,000, the authorized issue being $150,000. The engines manufactured by the company use the native cheap distillate and the company is about to bring out a simple apparatus which manufactures any kind of crude oil into a fixed gas, being taken direct into the engine, and producing, according to the builders, an economy far superior to anything possible with steam or distillate. The works of the company are located at 908 to 932 North Main Street. W. H. Frost is president.

Company Elections.

BIRMINGHAM, ALA.—At the annual meeting of the Birmingham Railway, Light & Power Company the following-named officers were elected: A. H. Ford, president and general manager; Lee C. Bradley, vice-president; J. P. Ross, secretary; E. M. Cory, treasurer, and E. C. Jolly, assistant treasurer.

PETALUMA, CAL.—At the annual meeting of the Petaluma & Santa Rosa Railway Company the following named officers were elected: W. A.

Cottell, president; J. A. McNear, vice-president; Thomas Archer, secretary and treasurer. An assessment of $10 per share was levied in December to wipe out a floating debt of $75,000 and to purchase additional equipment.

SAN FRANCISCO, CAL.—At the annual meeting of the Presidio & Ferries Railroad Company the following named officers were named: George C. Newhall, president; H. M. A. Miller, vice-president; J. P. Laighton, secretary, and William J. Dutton, treasurer.

MACON, GA.—At the annual meeting of the Macon Railway & Light Company the following-named officers were elected: W. J. Massee, president; Jacob S. Collins and M. Felton Hatcher, vice-presidents; J. E. Jaudon, secretary and treasurer, and J. S. McFarland, general superintendent.

ALTON, ILL.—At the annual meeting of the Alton Gas & Electric Company the following-named officers were elected: O. S. Stowell, president and treasurer; L. C. Haynes, vice-president; T. W. Gregory, secretary and assistant treasurer.

ALTON, ILL.—At the annual meeting of the Alton, Granite & St. Louis Traction Company the following-named officers were elected: L. C. Haynes, president; F. E. Allen, vice-president; T. W. Gregory, secretary and assistant treasurer, and C. A. Caldwell, treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the Citizens' Electric Light & Power Company the following-named officers were chosen for the ensuing year: L. C. Haynes, president; H. D. Sexton, first vice-president; M. S. Hopkins, second vice-president; T. W. Gregory, secretary and treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the East St. Louis & Suburban Railway Company the following-named officers were elected: C. M. Clark, president; L. C. Haynes, first vice-president; M. S. Hopkins, second vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and assistant treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the St. Louis & Belleville Electric Railway Company the following-named officers were elected: L. C. Haynes, president; M. W. Schaeffer, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant treasurer and assistant secretary.

EVANSVILLE, IND.—At the annual meeting of the Evansville & Southern Indiana Traction Company James Murdock was re-elected president, and Charles Murdock, secretary and treasurer.

DES MOINES, IA.—At the annual meeting of the Southern Iowa Telephone Company the following named officers were elected: D. N. Smith, president; L. M. Grimes, secretary, and E. A. Nye, treasurer.

LOUISVILLE, KY.—At the annual meeting of the Indianapolis & Louisville Traction Company the following-named officers were elected: J. M. Andrew, president; James C. Chaplin, first vice-president; W. L. Lyons, secretary and treasurer, and Alexander C. Thompson, assistant secretary and assistant treasurer.

LOUISVILLE, KY.—At the annual meeting of the Cumberland Telephone & Telegraph Company the following named officers were elected: James E. Caldwell, president; W. W. Berry, William Letterer and A. G. Sharp, vice-presidents; J. W. Hunter, Jr., secretary; T. D. Webb, treasurer, and Leland Hume, general manager.

DOVER, ME.—At the annual meeting of the Dover & Foxcroft Light & Power Company the following named officers were elected: C. C. Hall, president; E. A. Thompson, treasurer, and E. W. Crocker, clerk and superintendent.

PORTLAND, ME.—Articles of incorporation have been filed for the Hancock & Lake Linden Traction & Power Company, with a capital stock of $800,000. The incorporators are James E. Manter, Clarence E. Eaton, Charles D. Fullerton and Millard W. Baldwin, of Portland.

WELLS, ME.—At the first meeting of the Wells Electric Light & Power Company the following named officers were elected: J. W. Gordon, president, and J. H. Littlefield, secretary. The company hopes to be able to supply electricity for lamps this season.

ANNAPOLIS, MD.—A bill has been introduced in the House of Delegates incorporating the Baltimore & Pennsylvania Railway & Power Company. The company proposes to generate electricity to be used for street, commercial and residence lighting in any part of Baltimore and Carroll counties or in Pennsylvania; also to build and operate a railroad from Reisterstown through Hampstead and Manchester and thence to the Pennsylvania state line and in the state of Pennsylvania, to be operated by steam or electricity. The company is capitalized at $250,000 and the incorporators are: William Massenheimer, Charles J. Wells, Jesse A. Davis, Henry M. Foster and C. Dickerson Day.

ESCANABA, MICH.—At the annual meeting of the Escanaba Electric Street Railway Company the following named officers were elected: John K. Stack, president; O. B. Fuller, vice-president; I. C. Jennings, secretary and general counsel, and John J. Cleary, treasurer.

NEW RICHLAND, MINN.—At the annual meeting of the New Richland Telephone Company the following-named officers were elected: E. J. Batchelder, president; M. A. Hodgkins, vice-president and manager, and H. E. Johnson, secretary and treasurer.

ARCADIA, MO.—At the annual meeting of the Arcadia Mutual Telephone Company the following officers were chosen for the following year: G. W. Dick, president; A. L. Anderson, secretary, and E. E. Bish, treasurer.

ST. LOUIS, MO.—At the annual meeting of the Laclede Gas Light Company John I. Beggs was re-elected president; August Gehner, vice-president to succeed Breckenridge Jones, and P. E. Bisland, of New York, N. Y., also vice-president. The other officers are as follows: C. L. Holman, secretary; W. S. Dodd, treasurer; W. F. Kroyer, of New York, N. Y., assistant secretary, and E. B. Pray, of New York, N. Y., assistant treasurer.

PLATTSMOUTH, NEB.—At the annual meeting of the Plattsmouth Telephone Company the following named officers were elected: T. E. Parmelee, president; C. C. Parmelee, vice-president; T. H. Pollock, secretary and general manager, and J. N. Wise, treasurer.

NEW YORK, N. Y.—At the annual meeting of the United Electric & Power Company, Henry J. Hemmon, Cortland Betts and Arthur H. Elliott were elected to the board of directors, succeeding Osborne W. Bright, H. E. Gawtry and William Bunker. The other directors were re-elected.

ROCHESTER, N. Y.—At the annual meeting of the Rochester, Charlotte & Manitou Railroad Company the following named officers were elected: Michael Doyle, president; Herman Behn, vice-president; J. M. McGrath, secretary and treasurer, and R. S. Nagle, auditor.

ROCHESTER, N. Y.—At a meeting of the reorganization committee of the Home Telephone Company, held Feb. 5, the following named officers were elected: E. B. Odell, president; H. F. Miller, vice-president; Charles H. Poole, secretary and manager, and W. I. Taber, treasurer.

CLEVELAND, OHIO.—At the annual meeting of the Forest City Railway Company the following named officers were chosen for the ensuing year: M. A. Fanning, president; C. H. Miller, vice-president; Fred C. Alber, secretary and treasurer.

COLUMBUS, OHIO.—At the annual meeting of the Columbus Telephone Company the following-named officers were elected: Henry A. Lanman, president; Frank A. Davis, vice-president and counsel; Edwin R. Sharp, secretary and treasurer, and Gansey R. Johnson, general manager.

DEWEYVILLE, OHIO.—The directors of the Mutual Telephone Company at the annual meeting of the company elected the following-named officers: Scott Weisley, president; Frank Ritter, vice-president; Charles Ewing, secretary, and William Compton, treasurer.

FINDLAY, OHIO.—At the annual meeting of the Home Telephone Company the following named officers were elected for the ensuing year: E. C. Taylor, president; C. Y. McVey, vice-president; J. W. Vernor, secretary and manager, and H. B. Taylor, treasurer.

MARION, OHIO.—At the annual meeting of the Marion County Telephone Company the following named officers were elected: George W. King, president; S. E. Barlow, vice-president; D. M. Odaffer, secretary and general manager, and Oswald Wollenweber, treasurer.

ASTORIA, ORE.—At the annual meeting of the Astoria Electric Company the present officers were re-elected. D. I. McGee, of New York, N. Y., was elected manager of the company.

PITTSBURG, PA.—At the annual meeting of the Pittsburg & Allegheny Telephone Company the following-named officers were elected: J. G. Splane, president; John S. Weller, vice-president and general manager; Thomas G. Davis, secretary and assistant treasurer, and Robert C. Hall, treasurer.

SPARTANBURG, S. C.—The Greenville & Spartanburg Electric Railway Company has been chartered with a capital stock of $100,000 by O. K. Mauldin, H. H. Prince, A. A. Gates and C. C. Good. The company proposes to construct an electric railway from Greenville to Spartanburg.

DALLAS, TEX.—At the annual meeting of the Dallas Interurban Electric Railway Company the following named officers were elected: Henry Dorsey, president; I. J. Willingham, vice-president; S. A. Stemmons, secretary, and W. W. Caruth, treasurer.

SPOTSYLVANIA, VA.—At the annual meeting of the Spotsylvania Telephone Company the following named officers were elected for the ensuing year: George W. Perry, president; Norman L. Mills, vice-president; William B. Warren, secretary and treasurer, Manlins F. Waite, business manager.

POULSBO, WASH.—The Poulsbo Rural Telephone Company has been incorporated with a capital stock of $10,000 by John Stoseth, Paul Paulson, George C. Telen, Henry Nordahl, Nels Sonju, C. A. Johnson and John Ryen.

WAUSAU, WIS.—At the annual meeting of the Wausau Telephone Company the following officers were elected: Nathan Heinemann, president; E. B. Thayer, vice-president; James Montgomery, secretary, and W. W. Thayer, treasurer.

New Incorporations.

FOLEY, ALA.—The South Baldwin Telephone Company has been incorporated with a capital stock of $2,500 by C. L. Howe, E. A. Bemis, F. L. Babcock, of Magnolia Springs; J. V. Erksine and Frank Fesler, of Foley.

LITTLE ROCK, ARK.—A charter has been granted to the Paris, Subiaco Traction Company, with a capital stock of $60,000, for the purpose of constructing an electric railway from Paris to a point near Subiaco, a distance of five miles. The incorporators are: D. J. Young, Conrad Elsken, G. G. Danridge and Charles J. Jewett.

SAN FRANCISCO, CAL.—The Pacific Shipsmithing & Electric Company has been incorporated with a capital stock of $25,000 by F. A. Schaumleffel, C. O. Lundholm and L. P. Dunkley. H. C. Scharetzer, attorney.

SANTA ROSA, CAL.—The Magnolia Telephone Company has been incorporated with a capital stock of $10,000 with the following directors: D. M. Winans, president; T. C. King, secretary; G. B. Robinson, Jas. W. George and Diedrich Rangers.

LYNN CENTER, ILL.—The Lynn Center Telephone Company has been incorporated, with a capital stock of $2,500, by F. E. Peterson, A. Lundquist and F. L. Johnson.

GASTON, IND.—The Gaston Home Telephone Company, has filed articles of incorporation capitalized at $10,000. Charles W. Recor, Allen Oxley and Jas. M. Love are the directors.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis & South Bend Traction Company, with a capital stock of $10,000. The company proposes to construct and operate street and interurban railways. The directors are: Robert H. Keller, John Keller and Edward M. Bowman.

SEYMOUR, IND.—Articles of incorporation have been filed with the Secretary of State for the Seymour Mutual Telephone Company, with a capital stock of $30,000, by John A. Ross, William F. Bush, Fred Able, Leroy Miller, Fred H. Hickman and others.

SULLIVAN, IND.—The Marion Trust Company, of Indianapolis, has been appointed receiver of the Sullivan Electric Light Company. The company recently expended a large amount of money in remodeling and re-equipping the plant, which is the cause of its present embarrassment.

ELLSWORTH, ME.—The North Penobscot Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are E. H. Moore and others.

BOSTON, MASS.—A certificate of incorporation has been filed with the Secretary of State for the Connecticut River Transmission Company, with a capital stock of $10,000. The company proposes to generate and transmit electricity for heat and motors. The officers of the company are C. Arthur Fiske, president; William W. Brooks, treasurer, and Stanley R. Miller, a director.

COLRAIN, MASS.—The Colrain Electric Light Company has been organized, with the following officers: J. W. Cram, president; R. C. Hillman, secretary, and H. A. Smith, treasurer.

PALMYRA, MO.—The Palmyra Telephone Company has been incorporated, with a capital stock of $6,000, by Lewis Frazer, John A. Miller, George W. Pine, L. C. Henderson and others.

FAISON, N. C.—The Faison-Clinton Telephone Company has been incorporated, with a capital stock of $3,000, by H. C. Precise, J. M. Faison, M. M. Williams and others.

STATESVILLE, N. C.—The Amity Telephone Company has been incorporated, with a capital stock of $1,115, by J. S. Goodman, of Amity, and others.

ALDEN, OKLA.—The Alden Telephone Company has been incorporated with a capital stock of $10,000 by H. S. Sturgis, S. W. Carpenter, of Alden; Fred Brasted, of Oklahoma City, and others.

CASHION, OKLA.—The Silver Ridge Telephone Company has been incorporated by H. C. Marman, Orch Bryan and M. Winters.

GRACEMONT, OKLA.—The Gracemont & Binger Rural Telephone Company has been incorporated, with a capital stock of $2,000, by J. Knedson, R. H. Hering, Charles Vandeventer and W. H. Darwold, all of Gracemont.

VENUS, TEX.—The Venus Telephone Company has been incorporated with a capital stock of $3,000 to build a telephone system.

COURTLAND, VA.—Articles of incorporation have been filed for the Courtland & Burdette Telephone Company, with a capital stock of $500 to $2,000. The incorporators are R. Whitfield, president; G. W. Wade, vice-president; J. P. Johnson, secretary and treasurer; T. H. Birdsong, W. T. McLemore, Algar Woolfolk, all of Courtland.

LOUISA, VA.—The Citizens' Mutual Telephone Company has been incorporated with a capital stock of $5,000. The officers of the company are B. C. Goodwin, of Buckner, president; J. H. Parrish, of Bumpass, vice-president, and C. B. Meredith, of Willowbrook, secretary and treasurer.

POUND, VA.—The Lower Pound Telephone Company has been organized, with a capital stock of $2,000, by J. Greer, R. Lee Greer and others.

WHITTLES DEPOT, VA.—The Climax Telephone Company has been incorporated, with the following officers: George W. Anderson, president; W. S. Anderson, vice-president; John C. Shelhouse, secretary, and James B. Shelhouse, treasurer.

NORTH YAKIMA, WASH.—The Natchez Light & Water Company has been incorporated with a capital stock of $10,000 by James Barnes, J. E. Boyle and F. A. Luce. The company proposes to furnish water and light in the city of Natchez.

NORTH YAKIMA, WASH.—The Yakima Inter-Valley Electric Railway Company has filed articles of incorporation with a capital stock of $1,000,000, for the purpose of building and operating electric railways throughout the valleys of Yakima County. The first line from Granger to North Yakima, 34 miles in length, will be completed this year. The incorporators are H. H. Lombard, A. B. Wilcox, J. H. Thomas, C. H. Furman, Hector P. Eaton and C. E. Page.

RIVERSIDE, WASH.—The Okanogan County Telephone Company has been organized to construct and operate a telephone system in the towns of Riverside, Omak and Okanogan. The officers are: H. M. Fryer, president; J. Z. English, vice-president; Arthur Lund, secretary and treasurer, and A. M. Storch, superintendent of construction.

PINEVILLE, W. VA.—The Pineville Water & Light Company has been incorporated, with a capital stock of $10,000, by R. A. Kellers and others.

WHEELING, W. VA.—The Mozart Improvement Company has been incorporated, with a capital stock of $100,000, to construct and operate an electric power plant at Mozart Terrace. The plant will furnish electricity for lamps and motors and will be operated by gas engines. H. L. Hesse is secretary and treasurer.

MILWAUKEE, WIS.—Articles of incorporation have been filed with the Secretary of State for the Independent Telephone Company, of Milwaukee, with a capital stock of $10,000 The incorporators are H. D. Critchfield, R. W. Dunlap and J. C. Harper, of Madison.

TWO RIVERS, WIS.—The Two Rivers Telephone Company has been incorporated with a capital stock of $15,000 by M. F. Kirst and others.

WINDSOR, N. B., CAN.—The Farmers' Telephone Company has been incorporated with a capital of $5,000. The directors are: H. A. Smith, E. W. Spinner, G. O. Britton, F. W. Smith, all of Windsor.

Legal.

TELEPHONE COMPANY BOUND TO EXERCISE ONLY REASONABLE CARE IN KEEPING LINES IN WORKING ORDER.—Under a contract with the defendant telephone company, the plaintiffs advanced the necessary funds to build and equip an extension of the company's lines running to the town in which the plaintiffs lived. The company agreed to see that the work was properly done, and to maintain telephone service during the life of the contract, and the plaintiffs agreed on their part to see that the company would have a certain number of subscribers. After the erection of the line, the plaintiffs brought an action against the company to recover the money they had advanced, on the ground that the company had failed properly to maintain the telephone line. and had permitted the line and the boxes to be out of repair to such an extent as to destroy the value of the telephones. It was held that the evidence introduced was not sufficient to warrant a verdict in favor of the plaintiffs. It showed substantially that there was little or no trouble until after bad weather came in winter, and that the trouble then was incidental to the fact that it was a new line, a part of which ran through lands where the poles settled and the wires interfered. While there was delay in some cases in remedying defects, it was due to the situation of things, and there was nothing to indicate fraud or bad faith. The company was bound to the plaintiffs to use ordinary care to keep and maintain its telephones and lines in order, and, if it failed to exercise such care, it could be held by them for the damages they thereby sustained. But a subscriber to a telephone must know that it is liable to get out of order and that a line running through the country must in winter be expected sometimes to get down. The company is bound to use ordinary care in constructing and maintaining its line, but it is not responsible for those interruptions which may not be prevented by ordinary care. Eastern Kentucky Telephone & Telegraph Co. v. Hardwick, Court of Appeals of Kentucky, 106 N. W. Rep. 307.

RIGHT OF PERSON TO REMOVE POLE FROM PRIVATE ALLEY ABUTTING ON HIS PROPERTY.—A telephone company, having asked permission from the owner of a lot to erect a telephone pole in a private alley at the rear of the lot, and having been refused such permission. proceeded to place the pole in position without authority at a time when the owner of the lot was away from home. The top of the pole, as erected, and the cross arms, projected over the lot and when the owner returned and saw the pole in position he notified the company that if the pole was not promptly removed he would take steps to compel removal. The company made no reply to his letter but permitted the pole to remain in the alley, though it was straightened so that it did not project over the lot. The owner then cut the pole down and was sued by the telephone company for damages sustained by reason of the act. The decision was in favor of the defendant lot owner under the well-known rule that the planting of telephone or telegraph poles along a public highway, or a railroad right of way for other than railroad use, in the country where the title of the abutting owner runs to the center of the road subject to the right of way, is an appropriation of private property, and is unlawful, unless the right to do so has been acquired by contract or condemnation. The same principle applies with equal force to the planting of poles in a city on a private alley, such as the one in this case, where the title of the abutting owner extends to the center of the alley, although a different principle would control the erection of poles on the public streets of the city whose beds are owned by the municipality. The rule is the same whether the title of the abutting owner be a leasehold or a fee. It was held that the pole constituted a nuisance, which the lot owner had a right to abate. The company was armed with the power of condemnation of an easement for the erection of the pole, and if under those circumstances it proceeded forcibly and in entire disregard of the owner's rights to erect it so as to injure and annoy him it could not expect the law to be too strictly applied to him in its favor, when he, without any breach of the peace, cut the pole down. Maryland Telephone & Telegraph Co. vs. Ruth, 68 Atl. 358.

NO LIABILITY ATTACHES TO TELEPHONE COMPANY BECAUSE HORSE IS STRUCK BY LIGHTNING IN VICINITY OF ITS LINES.—The owner of a horse brought an action against a telephone company to recover damages for the death of the animal based on the following facts: The horse, having been turned into a pasture, through which ran the company's line consisting of three wires, was not seen again until found dead beneath the telephone wires, where it had been struck down by lightning. The wires were about eighteen inches apart and the middle one was about a foot lower in its construction than the other two. The horse was about six feet tall and at the place where he lay the middle wire was about six inches higher than his head, when standing. The examination of the horse after the storm, considered in the light of the height of the wire above him, disclosed rather positively that the wire did not come in contact with him. Neither were the wires crossed or together. There was not shown any structural or inherent quality or defect of the line or wire, or that it was out of repair or maintenance at the time. The lightning in its course shattered the cross-arm separating the wires from contact on a pole distant therefrom, and cut a swath of grass underneath 3 ft. wide beneath the wires, extending from a point 30 steps from the horse on the ground sloping north toward the horse and beyond him 12 or 15 ft. Two wires of a barbed-wire fence on the south side of the pasture had been broken from several posts and rolled up. The question to be determined, said the Court, is this: "Was the horse killed by electricity which came from the wires, or directly by a bolt of lightning from the clouds? If the same bolt of lightning struck both the telephone line and the horse, but if the wire did not control the path of the bolt from the clouds to the earth so as to be the proximate cause of the bolt's striking the horse, the appellant as a matter of law would not be liable. It is not sufficient that the wire was a possible consequence of conducting the lightning to the horse. The proof in the record, properly construed, as a matter of law, would not warrant the finding by a jury that the wire or telephone line was the efficient cause of the bolt of lightning's striking the horse, or leaping to the horse's body from the telephone wire suspended out of his reach." Southwestern Telephone & Telegraph Co. v. Morris, Court of Civil Appeals of Texas, 106 S. W. Rep. 426.

Personal.

MR. C. HOLDEN has been appointed superintendent of the municipal electric light plant at Moosejaw, Sask.

MR. A. E. GURNEE has been appointed treasurer of the New York & New Jersey Telephone Company, to succeed Mr. H. S. Snow, resigned.

MR. WILLIAM K. HOWARD has been elected superintendent of the municipal electric light plant at Fredericksburg, Va., to succeed Mr. E. M. Green, resigned.

MR. P. E. HALL, JR., of Everett, Wash., has been appointed general manager of the Montesano Light & Water Company, of Montesano, Wash. Mr. W. E. Meyer will be retained as local manager of the plant.

MR. THOMAS A. EDISON was the guest at a dinner given in Newark, N. J., last week in honor of his 61st birthday. His hosts were the heads of the various departments in his West Orange laboratory.

MR. S. W. HUFF, general manager of the Virginia Passenger & Power Company, has been elected president of the Coney Island & Brooklyn Railroad Company, of Brooklyn, N. Y., to succeed Mr. John L. Heins, who recently resigned.

MR. ROBERT McF. DOBLE, consulting and supervising engineer making a specialty of hydro-electric power development and transmission, formerly of San Francisco, has removed his office from Colorado Springs to Majestic Buildings, Denver, Col.

MR. ARTHUR H. ALLEN, formerly with the Westinghouse Electric & Manufacturing Company, has been appointed district agent for the Triumph Electric Company, of Cincinnati. Mr. Allen will have his office at 1019 Land Title Building, Philadelphia.

MR. C. H. DAVIS, formerly manager of the Chicago office of the Nernst Lamp Company, on March 1 will take charge of the electric railway details department of the Westinghouse Electric & Manufacturing Company at the East Pittsburg Works.

PROF. ROLAND CARLBERLA, of Columbia University, presented a paper entitled "Manufacture of Ferro-Chrome in the Electric Furnace" at a meeting of the New York Section of the Society of Chemical Industry, held in the Chemists' Club, Feb. 21.

MR. W. E. GILMORE, of Orange, N. J., who for many years has been actively and prominently identified with Edison manufacturing interests there, has been admitted as a special partner into the Consolidated Exchange firm of G. Edward Graff, of New York City, having offices both uptown and downtown.

MR. JOHN FRITZ, of Bethlehem, the veteran iron master, has been elected a member of the board of trustees of Lehigh University and has accepted the position. His universally recognized high standing among the engineers of the country makes this addition to the board of trustees of this leading technical institution eminently fitting.

MR. A. G. WESSLING, who has been with the Bullock works of the Allis-Chalmers Company as a designing engineer for many years past, resigned recently for a year of travel and study abroad in Great Britain and on the Continent. He sailed last week from New York on the *Cedric*. Mr. Wessling is a graduate of Cornell University.

MR. PETER COOPER HEWITT has entered the competition for the supply of a war balloon to the U. S. Army, and has offered a bond of $20,000 for a balloon, to be finished in 200 days. Mr. Hewitt recently announced that he, in connection with Mr. Miller Rees Hutchinson, was experimenting on a balloon which would make 60 miles an hour.

MR. HENRY DOCKER JACKSON is tkaing a vacation in Bermuda, having finished an important piece of work for the city of Brockton. He has formed an association with Mr. Harold Y. Currey, of Chicago, and is making plans for an association on the Pacific Coast as well. Hereafter he will extend his field, to include Mexico, the United States and Canada.

PROF. D. C. JACKSON, head of the department of electrical engineering, Massachusetts Institute of Technology, has been retained by the Massachusetts Highway Commission, and will make a preliminary report regarding the telephone situation in the State, with special reference to the practicability of a reduction in rates and a higher efficiency of service.

MR. H. C. KAERSCHNER has been appointed superintendent of motive power of the Hudson Valley Railway Company, of Glens Falls, N. Y., to succeed Jesse D. Abell, resigned. Mr. Kaerschner's appointment took effect on Feb. 1, but until March 1 he will have charge of the power plants and electrical appliances of the Hudson Valley Railway. After that date he will assume charge of the rolling stock.

MR. EDGAR B. GREENE, who for several years has been most successfully identified with the management of the lighting system at Altoona, Pa., will celebrate, with Mrs. Greene, on Feb. 20, the 25th anniversary of their marriage. They are in receipt of congratulations from a host of friends, particularly those in the National Electric Light Association and the Association of Edison Illuminating Companies.

MR. S. W. HOUGH has resigned as general manager of the Virginia Passenger & Power Company, of Richmond, Va., and will succeed Mr. John L. Heins as president of the Coney Island & Brooklyn R. R. Company. Mr. Hough was at one time assistant superintendent of the Baxter Electric Motor Company, of Baltimore. Since that time he has been connected with street railway work in Raleigh, N. C., Baltimore, San Francisco, Philadelphia, and Richmond, Va.

DR. A. PIRELLI, of the firm of Pirelli & Co., the great Milan firm making insulated wires and cables, automobile tires, etc., is again in this country and will stay a few weeks. The Pirelli tires are used on the Zust car from Italy, which started from New York on Feb. 12 via Alaska to Paris, as they were also on the car of Prince Borghese, which made the famous trip from Pekin to Paris. Dr. Pirelli takes great interest in this department, but devotes his attention largely to the electrical side of the industry.

MR. WYNN MEREDITH has become a partner in the firm of Sanderson & Porter, of 52 William Street, New York, N. Y., and will have charge of the Western office, which they have opened in the Union Trust Building, San Francisco, Cal. Mr. Meredith was actively connected with the engineering and operation of the electrical plant of the World's Fair at Chicago, Ill., in 1893, and the California Fair in 1894, subsequently becoming associated with Messrs. Hasson & Hunt, and later a member of the firm of Hunt, Dillman, Meredith & Allen, of San Francisco, Cal.

MR. A. H. ACKERMANN, formerly in charge of the meter and test departments of the New York Edison Company, and who joined the staff of the Electric Storage Battery Company as engineer of the New York office about two years ago, has recently resigned from the latter company to accept an offer from the Studebaker Brothers Company of New York to become their sales engineer. Mr. Ackermann will devote himself to the electric vehicle department, both of commercial and pleasure type. He will cover the entire eastern territory, though his headquarters will be in New York City.

Obituary.

MR. WALTER I. BARNES, assistant general manager of the Narragansett Electric Lighting Company, died last week at his home in Manton, R. I., after an illness covering a period of two years, during the final nine months of which he was confined to his house. Mr. Barnes entered the employ of the Narragansett Electric Lighting Company in 1891 as a salesman and worked up to the position of general superintendent, which he occupied from July, 1895, until his appointment as assistant general manager, which occurred just prior to the beginning of his illness. He was born Dec. 20, 1859, and after a common school education graduated from the commercial school of Bryant & Stratton.

PROF. W. F. C. HASSON, at one time a considerable factor in the electrical engineering field, died at Annapolis, Md., Friday, Feb. 14. Prof. Hasson upon graduation from Woodward College, Cincinnati, as gold medalist in 1876, entered the Naval Academy as cadet-engineer and was graduated therefrom third in his class, four years later. After a cruise on the Asiatic Station he served several years as professor of mechanical engineering at the University of Nebraska. Upon returning from a cruise around the world following this duty he was stationed

at San Francisco and resigned from the naval service in 1893. In that year he took a prominent part in the proceedings of the international electrical congress of Chicago, particularly in the discussion of high-tension transmission problems of the day. In the early part of 1894 he organized and conducted, as chief electrician, the electrical department of the Midwinter fair, which achieved a notable success as an electrical show. Shortly after he entered into partnership with Mr. A. M. Hunt, also formerly of the navy, and the firm of Hasson & Hunt carried through some of the most important transmission and railway work of the period on the Slope. Owing to ill health Mr. Hasson retired from the firm about ten years ago, and after a residence of several years in Hawaii, accepted an appointment in the department of mathematics at the U. S. Naval Academy. Prof. Hasson was a man of lovable disposition and brilliant intellect, whose withdrawl from active work in the electrical engineering field was a distinct loss to the profession and the industry.

Unclassified Items.

DES MOINES, IA.—At the annual meeting of the Des Moines City Railway Company the following named officers were elected: George B. Hippe, president; Harry H. Polk, vice-president; H. T. Guernsey, secretary; G. B. Hippee, treasurer, and A. G. Maish, general manager.

HARTFORD, CONN.—At the annual meeting of the Hartford Electric Light Company the following named officers were elected: A. C. Dunham, president; S. G. Dunham, vice-president; Curtis C. Cook, secretary and assistant treasurer, and D. N. Barney, treasurer.

PROVIDENCE, R. I.—At the annual meeting of the Providence Telephone Company the following named officers were elected for the ensuing year: Dexter B. Potter, president; Fenner H. Peckham, vice-president; Charles T. Howard, secretary and treasurer, and Joseph F. Beck, general manager.

MONROE CITY, MO.—The plant of the Ralls County Electric Light & Power Company has been sold by R. F. Roy, trustee, to P. W. McGown, who will make improvements to the same.

BLOOMFIELD, MO.—The Bloomfield electric light plant has been purchased by Rudolph Houck and A. D. Wilcox. A company will be incorporated to operate the plant.

MARYVILLE, MO.—Considerable new machinery is being installed in the electric light plant here with a view to increasing the service.

JOHNSON CITY, TENN.—The Watauga Electric Company is installing a 400-kw dynamo which will nearly double the output of the plant. The company furnishes electrical energy for the city lighting system and also to the Johnson City Traction Company.

PEARSALL, TEX.—The Orella Telephone Company has been incorporated with a capital stock of $50,000 by Jesse H. Jones, E. C. Lamb and D. E. Garrett.

ADRIAN, MICH.—At the annual meeting of the Citizens' Light & Power Company the following named officers were elected for the ensuing year: J. H. Fee, president; G. A. Wilcox, vice-president; Henry A. Wing, secretary; C. E. Baldwin, treasurer, and H. A. Fee, general manager.

HARMONY, N. C.—The Harmony Telephone Company has been incorporated with a capital stock of $5,000 for the purpose of erecting and operating a telephone system between this city and Statesville and other points in Iredell, Davie, Alexander and Yadkin Counties.

BRAWLEY, CAL.—The injunction issued against the Holton Power Company restraining them from wasting water into the Salton Sink became effective Feb. 12, and caused the shutting down of its plant at Holtville, with the result that all the towns in the Imperial Valley are without electrical service. It is expected that the service will be restored within a few days, as the company's auxiliary plant is nearly completed.

RENO, NEV.—The machinery for the new substation of the Reno Power, Light & Water Company, is now being installed in the old power house. The equipment of the station consists of two large transformers and a 375-kw generator. As soon as the plant is completed the high-tension wires of the company will be removed from the streets, and the two substations in the city will be abolished. The cost of the improvements is placed at $25,000.

WASHBURN, WIS.—The city has purchased the outside equipment of the Washburn Electric Light & Power Company. F. W. Downs is superintendent of the municipal plant.

WEAVERVILLE, CAL.—Arrangements are being made to install electrical equipment at the Brown Bear Mine at Deadwood.

CALISTOGA, CAL.—An attachment has been placed on the entire plant of the Calistoga Electric Light & Power Company in this place, and the power house and machinery now under construction and installation at Barrow. The attachment is the outcome of two suits filed in the superior court Feb. 9 by H. H. Brown, president of the Bank of Calistoga to recover moneys due. The plant has been placed in the hands of Lee Hopper, of Calistoga, who will act as keeper.

BETHEL, VT.—The Bethel Printing Company has installed a 2-hp motor to operate its printing presses by electricity. Energy for operating the motor will be furnished by the Bethel Electric Light & Power Company. Several other industries using a small amount of power are contemplating installing electrical service.

MR. S. P. GRACE, chief engineer of the Bell Telephone Company, of Pittsburg, has been elected a director of the Engineers' Society of Western Pennsylvania. This society now numbers nearly a thousand members and has become an important factor in the industrial development of Pittsburg.

MR. GEORGE E. BRUEN has been appointed engineer for the Underwriters' Laboratories, Inc., which have been moved from 29 West Thirty-ninth Street to the twelfth floor of the building at 135 William Street, where the offices of the National Board of Fire Underwriters are also located. Mr. Bruen is employed in an engineering capacity by the National Board and will take up the laboratory work in connection with his other duties, and have charge of the business of that corporation in and around New York City.

Business Notes.

THE DALE ELECTRIC COMPANY, New York, is about to put on the market a new Universal Portable, designed especially for use on roll-top desks and stenographers' desks. By means of swivel joints the light may be adjusted to any position desired.

THE F. BISSELL COMPANY, Toledo, Ohio, announces that for 1908 it will have an unusually large stock of cedar poles. Besides a large supply of both larger and smaller sizes which it is now cutting in Idaho and Michigan, there is a supply already at its yards sufficient to take care of any immediate demand.

THE AMERICAN ENGINE COMPANY reports that the increased business consequent upon the manufacture of its new engine, the "Angle-compound," has necessitated a large addition to its plant at Bound Brook, N. J., where even in these troublous financial times they have for some weeks been running both day and night shifts.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., suffered the loss by fire of one of its rope shops on Feb. 5. The shop destroyed, compared with the other shops, was of minor importance. Owing to the fact that business in general has been somewhat depressed and that at this season of the year the demand for wire rope is always less than during the spring and summer months, the facilities of the rope shops have not been overtaxed, and the productive capacity of the remaining shops will enable the company to continue prompt shipments of wire rope to its customers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 11, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

878,496. SYSTEM FOR CONTROLLING THE MOTION OF ELECTRICALLY-OPERATED ELEVATORS BY MEANS OF A SWITCH; William Baxter, Jr., Jersey City, N. J. App. filed May 21, 1902. A system for controlling the motion of electrically-operated elevators by means of a switch located within the car. Covers complete electrical and mechanical features.

878,498. SWINGING ELECTRIC BRACKET; J. F. Brown, Toledo, Ohio. App. filed July 8, 1907. A sliding contact for completing the circuit connections in an electric wall fixture, so that the circuit wires will not be bent and broken.

878,520. MEANS FOR TYING WIRES TO INSULATORS, ETC.; L. W. Gerdon, Meadville, Pa. App. filed Oct. 14, 1907. Patentee makes use of a tie for binding the line wire to the insulator and consisting of two members, each of which completely encircles the insulator, and intersecting at the point where the line wire is tangent to the insulator.

878,551. PROTECTING HOOD FOR SPARK PLUGS; D. B. Mills, East Orange, N. J. App. filed Feb. 2, 1906. A protector for electric terminals, particularly for the central terminal of spark plugs. Is designed to prevent the formation of a conducting film of moisture.

878,586. PUSH BUTTON SWITCH; H. C. Williamson, New York, N. Y. App. filed May 17, 1906. A two-button snap switch, having a depressible latch, which is engaged by a cam to release the switch element.

878,591. SWITCH DEVICE; Karl Abel, et al., Vienna, Austria-Hungary. App. filed Jan. 25, 1907. A switch device with four cross-wise connected fixed contact pieces, which can be connected to alter the direction of the current.

878,629. ELECTRIC MERCURY-MOTOR METER; Jacob H. Hodde, Springfield, Ill. App. filed March 16, 1907. Has a body of mercury and a spindle rotating therein, and a washer loosely surrounding said spindle at the point where the spindle enters the body of the mercury.

878,633. KEY SOCKET; H. Hubbell, Bridgeport, Conn. App. filed March 5, 1907. A single pole key socket designed to be very cheaply constructed.

878,634. SOCKET SHELL CAP FASTENING; H. Hubbell, Bridgeport, Conn. App. filed Sept. 5, 1907. Means for attaching the caps to electric socket shells, so that the cap is rigidly secured to the shell and readily detachable therefrom when required.

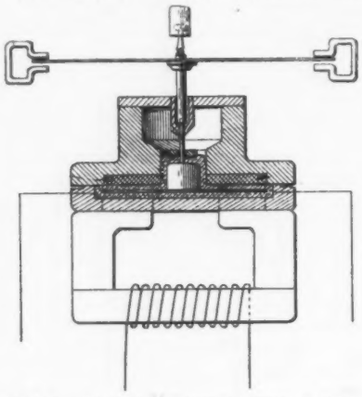
878,646. HIGH-POTENTIAL INSULATOR; Fred M. Locke, Victor, N. Y. App. filed April 18, 1904. A wire insulator, comprising con-

centric rings, having their ends spaced apart and terminating in different transverse planes.

878,653. TROLLEY PULLEY; E. J. Matthews, et al. In place of the usual trolley harp, patentee has a wheel with radially extending spokes which maintain a device in position over the trolley wire, but permit the latter to travel over the tops of specially constructed hangers.

878,656. TROLLEY WHEEL; J. T. Mishler, Johnstown, Pa. App. filed Aug. 10, 1907. The trolley wheel has spiral grooves communicating with the central grooves so as to insure the replacement of the wire.

878,661. SYSTEM OF ELECTRICAL DISTRIBUTION; R. S. McLeod. App. filed July 11, 1904. Dynamo electric machine for



878,620.—Electric Mercury Motor Meter.

regulating the charge and discharge of storage batteries. Comprises a reversible booster connected in series with the battery across the mains.

878,679. SUPPORT FOR INSULATORS; W. N. Smith, Yonkers, N. Y. App. filed April 28, 1906. Patentee has cast-iron insulator support clamped to the cross-arm of the pole by a U-shaped staple with threaded ends.

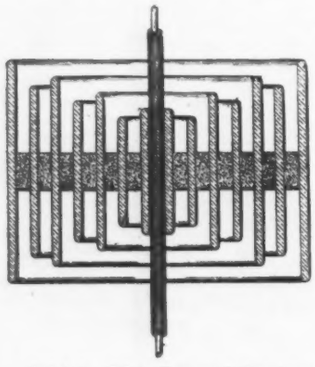
878,688. ELECTRIC HEATED HAND MOLDER FOR FILLING SHOES; A. Thoma, Cambridge, Mass. App. filed June 11, 1907. A small tool having a flat blade with a resistance element assembled against the rear face thereof so as to warm the same.

878,708. HEATED STEERING WHEEL; C. Berg, New York, N. Y. App. filed March 25, 1907. Patentee provides a hollow steering wheel for an automobile, and embodies a resistance element therein to warm the same.

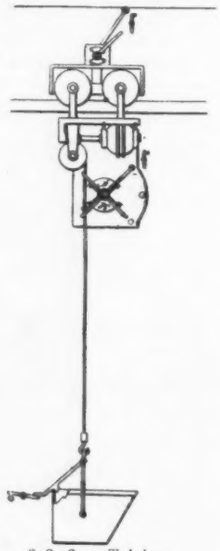
878,710. ELECTRICAL VAPOR APPARATUS; H. L. Campbell, et al., Nashville, Tenn. App. filed Feb. 18, 1907. Has a vessel in which is formed an electric arc and through which air under pressure is forced.

878,756. CONTROLLER; W. J. Warder, Jr., Chicago, Ill. App. filed May 13, 1907. A form of starting or speed controlling rheostat for electric motors having a ratchet mechanism, by which it is impossible to turn on the controller too rapidly.

878,779. PARTY-LINE TELEPHONE SYSTEM; Wm. W. Dean, Chicago, Ill. App. filed Jan. 22, 1904. In a party line telephone system, the combination with a telephone line, of a plurality of substations located on the line, a harmonic device at each substation adapted to respond to current of predetermined frequencies, a bell also at each substation, a shunt circuit



878,646.—High Potential Insulator.



878,787.—Telpher.

of the bell adapted to be continuously broken during the actuation of the device, and a source of current at the central office for each substation adapted to impress current upon the line of the proper frequencies to operate said harmonic devices, substantially as described.

878,791. SUPERVISORY APPARATUS; K. Friedlaender, Berlin, Germany. App. filed Jan. 31, 1906. Signal system for night illumination of factories and warehouses where the lights glow faintly at all times, but are lighted brilliantly during the passage of the watchman in his patrol.

878,797. TELPHER; H. M. Harding, et al., New York, N. Y. App. filed April 13, 1905. A complete electric telpher system having means by which the operation of both the hoisting and the telpher motors are controlled entirely automatically. The arrangement is such that the bucket is hoisted, dumped, returned and again lowered automatically after once being started into operation.

878,816. SLEEVE FOR JOINING WIRE ENDS; F. W. Maxstadt, Los Angeles, Cal. App. filed Nov. 7, 1904. A sheet metal sleeve shaped like figure 8 in section and spirally twisted to enclose the circuit wires to be connected.

878,836. SECURING DEVICE FOR TROLLEYS; E. D. Trickey, Blanchester, Ohio. App. filed April 17, 1907. Patentee has a pair of spring-impelled arms projecting upward from the trolley harp and adapted to close over the wire.

878,855. SYSTEM FOR CONTROLLING THE OPERATION OF ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed July 10, 1905. A system of contactors for electric motors, by which they are controlled from a distant point by the actuation of push-button contacts in the pilot circuit.

878,870. INSULATOR SUPPORT; T. J. Creaghead, Covington, Ky. App. filed May 19, 1902. Patentee has a cast-iron support for an insulator of X-shaped transverse section with a stud bolt for connecting it to the pole arm.

878,877. ELECTRIC CLOCK; N. Friedman, New York, N. Y. App. filed Nov. 2, 1906. A self-winding clock having a motor with a shaft having a pinion, the shaft being larger than the pinion, to prevent backward rotation of the shaft by power applied to the pinion.

878,894. SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; C. F. Pike, Philadelphia, Pa. App. filed Oct. 19, 1901. Details of circuits of a block signal system, making use of special equipment throughout and having certain functions affected by the movement of the controllers on the cars.

878,919. ELECTRIC HEATER; W. R. Whitehorne, Brooklyn, N. Y. App. filed April 22, 1907. Electric heating means for dye vats designed to obviate the possibility of any electrolytic action which might affect the liquor or compounds in the vat.

878,923. SINGLE-PHASE MOTOR; James J. Wood, Fort Wayne, Ind. App. filed April 26, 1906. In a single-phase motor, a rotor winding provided with both commutator and collector rings, connections for supplying current from an external source to said commutator and collector rings alternatively, and a stator winding short-circuited upon itself on a definite line.

879,963. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 3, 1906. Arrangement for telegraphy over lines of comparatively large capacity.

878,949. ELECTRIC WIRE INSULATOR; J. H. Hanson, Chicago, Ill. App. filed Jan. 12, 1907. A rectangular porcelain insulator having undercut transverse passages to receive the circuit wires so as to automatically lock them in place.

878,952. ELECTRICALLY HEATED SOLDERING AND BRANDING IRON; H. Hertzberg, et al., New York, N. Y. App. filed April 5, 1907. A soldering iron having a rectangular metallic chamber in which is received a spirally wound resistance element.

878,961. CONTROLLER FOR ELECTRIC MOTORS; P. N. Jones, Pittsburg, Pa. App. filed Aug. 12, 1907. Controllers for electric motors having two or more controllers with suitable mechanism, whereby the controllers can be simultaneously operated to regulate and reverse the current to the motors.

879,033. INSULATOR FOR ELECTRIC WIRES; J. Caldwell, Philadelphia, Pa. App. filed Aug. 7, 1907. A cylindrical insulator having deeply cut grooves on planes to produce a triangular transverse section of the insulator therebetween.

879,034. TROLLEY POLE CONTROLLER; J. J. Coit, Venice, Cal. App. filed Oct. 20, 1906. The trolley harp is pivoted to the upper end of the pole, and a small piston is effective to keep the wheel pressed upward against the wire. Additional pneumatic mechanism operates to retrieve the pole or control it in other ways.

879,035. CABLE-TERMINAL; Frank B. Cook, Chicago, Ill. App. filed May 28, 1906. A cable terminal, comprising a sheet metal distributing plate, sheet metal channel portions secured to the said plate in a vertical position, sheet metal rings mounted to the said channel portions between same, and protective apparatus suitably mounted around the said sheet metal rings.

879,046. ELECTRICALLY HEATED SAD IRON; H. Hertzberg, et al., New York, N. Y. App. filed April 5, 1907. Patentee has a flat iron with a hollow interior, in which is received a spirally wound resistance element which is clamped tightly in place by wedge blocks.

879,061. RECTIFIER FOR ALTERNATING CURRENTS. George W. Pierce, Cambridge, Mass. App. filed Jan. 11, 1907. In an electrical apparatus, a rectifier for alternating currents, consisting of carborundum.

879,062. RECTIFIER AND DETECTOR; George W. Pierce, Cambridge, Mass. App. filed April 5, 1907. A rectifier for oscillatory currents, consisting of a conductive oxid of titanium.

879,073. TELEPHONE AND STATION APPARATUS; Nuchim L. Weingott, Warsaw, Russia. App. filed Dec. 30, 1907. The combination with a telephone and a key connected thereto and carrying the conductor terminals of said telephone, of station contact apparatus comprising movable contact parts, said last-named contact parts being connected to the wires of the telephone system.

879,083. ELECTRIC-INCANDESCENT-LAMP LUMINANT AND THE PROCESS OF MANUFACTURING IT; Francis M. F. Cazin, Hoboken, N. J. App. filed Nov. 30, 1903. In an electric incandescent lamp a filament-shaped luminant, which consists of a primary core-fillet, plated electrolytically with metal-alloy.

879,084. MANUFACTURING OF FILAMENTS IN ELECTRIC INCANDESCENT LAMPS, PROCESS AND PRODUCT; Francis M. F. Cazin, Hoboken, N. J. App. filed May 31, 1904. A glower-filament in an electric incandescent lamp, which glower-filament consists of a metallized carbon-fillet, the metallization of which fillet consists of electrolytic alloy-deposits in concentrical layers, the inner layer consisting of metals of the ruthenium-osmium class and being on its contact with the carbon inter-impregnated therewith, and the outer layer of which consists of rare metals, the surface of which is covered with oxids.

879,085. FILAMENT IN ELECTRIC INCANDESCENT LAMPS AND ITS MANUFACTURE; Francis M. F. Cazin, Hoboken, N. J. App. filed June 2, 1904. A filament in an electric incandescent lamp, which consists of a central core and of adhesive concentrical layers thereon, the layers consisting of electrolytical deposits, and the ends of which filament increase in thickness towards the terminals.

879,068. INSULATOR FOR HIGH-TENSION CURRENTS; L. Steinberger, New York, N. Y. App. filed Aug. 12, 1907. Patentee has an insulator with a ribbed top surface over which is placed a laterally projecting cover so as to shed water from the ribs.

879,117. RECTIFIER AND DETECTOR; George W. Pierce, Cambridge, Mass. App. filed April 5, 1907. A reflector for oscillatory currents, consisting of a compound of silver and tellurium.